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# Honeywell

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## **Honeywell Facility Claymont, Delaware**

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### Facility Lead RCRA Corrective Action **RFI Data Summary Report**

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*October 2003*

**Technical Review Comments  
for  
Honeywell Claymont  
RFI Data Summary Report  
Dated October 2003**

**DRAFT**

1. Section 2.1.2, page 2-2: The top paragraph states that the monitoring wells installed during the RFI did not advance through the alluvial deposits. However, the subsequent paragraph states that during the installation of MW-1 and MW-3, unconsolidated sediments were encountered. Are these sediments different from the alluvial deposits described in the previous paragraph? If so, please describe the differences.
2. Section 3.4, page 3-5 (also see comment 8): Given that Honeywell found a concrete slab which extends beyond the area drawn, further work on determining the extent of the unit may be required.
3. Section 3.10, page 3-10: The test pits that are located outside the unit contain elevated PID readings. Also, although the orientation of the geophysical data is unclear, it appears that there may be buried material near the tank. Please explain your reasoning for not considering the locations with the elevated PID readings as part of the unit.
4. Section 4.2, page 4-2 (also see comment 18): Honeywell must provide the location/source for the screening criteria. For example:
  - Are the values for the Soil to Groundwater Migration Soil Screening Levels from the Region 3 RBC table or the EPA Soil Screening Guidance?
  - What is the source of the Ingestion of VOCs value?
  - What ecologic criteria is being used?
  - Are you comparing non-carcinogens against 0.1 times the ingestion values?
5. Section 4.3: Once Honeywell clarifies the screening criteria, (see comment 4 & 18), Honeywell should consider whether that criteria is appropriate for screening the sample given the likely exposure pathways. For example, it is not necessary to screen subsurface soil data relative to ecologic screening criteria or to screen samples greater than 15 feet against phytotoxicity. In order to minimize revisions, EPA recommends eliminating most of Section 4.3 (pages 4-6 through 4-43) and including the relevant screening criteria (e.g. SSLs) on the figures.
6. Section 6.0: Appropriate screening criteria should be discussed with EPA. For example, since the Delaware River is not used as a drinking water source, screening the analytical

**RFI DATA SUMMARY REPORT**

**HONEYWELL FACILITY  
CLAYMONT, DELAWARE**

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**October 2003**

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## LIST OF ACRONYMS AND ABBREVIATIONS

bgs	Below ground surface
AOC	Administrative Order of Consent
CRP	Community Relations Plan
DMP	Data Management Plan
DNREC	Delaware Department of Natural Resources and Environmental Control
DQO	Data Quality Objectives
EDD	Electronic Data Deliverables
EI	Environmental Indicator
FLP	Facility Lead Program
Ft	Feet
IDW	Investigation-Derived Waste
IRM	Interim Remedial Measures
mg/kg	Milligrams per kilogram
NPDES	National Pollutant Discharge Elimination System
PADEP	Pennsylvania Department of Environmental Protection
PADER	Pennsylvania Department of Environmental Resources
PMP	Project Management Plan
PSO	Project Safety Officer
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
SCM	Site Conceptual Model
SCMPP	Sample Collection Methods and Procedures Plan
SI	Site Investigation
SVOCs	Semi-volatile Organic Compounds
SWMUs	Solid Waste Management Units
TAL	Target Analyte List
TCL	Target Compound List
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds

## 1.0 INTRODUCTION

This document presents the results of the *Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)* for the Honeywell International Inc. (Honeywell, formerly AlliedSignal) facility (Facility) in Claymont, Delaware (Figure 1). The RFI was performed as required by the USEPA Region III's Facility Lead Corrective Action Agreement, in accordance with Honeywell's Letter of Commitment (January 20, 2000) and the *RCRA Facility Lead Corrective Action Reference Documents* (USEPA Region III, 2000).

### 1.1 REGULATORY HISTORY AND BACKGROUND

The Honeywell Facility, once part of the Allied Chemical Corporation Delaware Valley Works (later renamed AlliedSignal, Inc.), has been in operation for nearly 100 years. The Facility is located in a heavy manufacturing area on the Delaware – Pennsylvania state line and is surrounded by the Sun Oil Refinery to the north and east, the Epsilon Chemical Company to the northeast, the Amtrak rail line to the northwest, and General Chemical, who owns parcels of the north and south plant areas following the divestiture in 1986 (Figure 2). The surrounding area has historically been used for heavy manufacturing, and there are no plans to convert surrounding property to other uses.

On May 21, 1986, General Chemical Corporation acquired several parcels and associated operations of the Delaware Valley Works, totaling 100 acres. The remaining property (36 acres) and operations were retained by Honeywell. The relative locations of the parcels and their ownership are indicated on Figure 2. Additionally, Figure 2 illustrates the portions of the plant that are referred to as the North Plant and South Plant.

DDT Over the years, the Honeywell facility manufactured chemical products including pesticides (DDT and TDE), organic and inorganic acids, and various other specialty chemicals. Currently, Honeywell has three primary product lines: boron trifluoride ( $\text{BF}_3$ ), a reaction catalyst used in a variety of process applications; oximino silanes, additives to silicone sealants; and Hocal, a chemical intermediate used in the agriculture industry. The Facility has always manufactured chemicals and the wastes generated by the chemical manufacturing process are highly diverse. In general, solid waste, gypsum, iron oxide mud, and alum mud

are the waste types that were placed in the solid waste management units (SWMUs) that were investigated during this RFI.

Based on the treatment, storage, and disposal of hazardous waste at the Honeywell Facility, a Notification of Hazardous Waste Activity was submitted to USEPA on July 28, 1980. For a detailed list of notifications/events see the Revised RFI Work Plan dated October 2002.

It should be noted that Honeywell and General Chemical are each implementing separate RCRA Corrective Action Programs. Honeywell will be using a Facility Lead Corrective Action Agreement, while General Chemical will be using a unilateral AOC. Though the two programs will be implemented and regulated separately, information and data gathered during the programs will be shared as appropriate, to maximize the efficiency and effectiveness in meeting the final remedy objectives. The same Region III Project Manager, Mr. Russell Fish, currently oversees the investigation of both sites.

## **1.2 PURPOSE**

By agreeing to participate in the Facility Lead Corrective Action Program, Honeywell committed to:

- Determining the extent and sources of all releases of hazardous waste or hazardous waste constituents at or from its portion of the facility using multimedia quality data;
- Evaluating and meeting the USEPA's Environmental Indicators (EIs);
- Performing interim measures at the Facility to prevent or mitigate unacceptable threats to human health and the environment;
- Conducting effective public involvement, and
- Communicating regularly with EPA, the Commonwealth of Pennsylvania, the State of Delaware, and the community on corrective action progress at the Facility.

### **1.3 REPORT ORGANIZATION**

This RFI Data Summary Package is organized into seven parts:

- Section I – Introduction, Site Regulatory History
- Section II – Physical Setting and Hydrology
- Section III – SWMU Descriptions
- Section IV – Soil Analytical Results
- Section V – Groundwater Analytical Results
- Section VI – Surface Water Analytical Results
- Section VII – Groundwater Flow Assessment

## **2.0 PHYSICAL SETTING AND LOCAL HYDROGEOLOGY**

### **2.1 PHYSICAL SETTING**

The physical and environmental setting of the Facility is described in the following subsections which focus on the physical setting including geology, hydrogeology and surface water interaction and their potential to impact groundwater flow at the site.

#### **2.1.1 Regional Geology**

The Honeywell Delaware Valley Works Facility is located within the Coastal Plain Physiographic Province. The Coastal Plain consists of unconsolidated sediments from the Cretaceous, Tertiary, and Quaternary ages overlying pre-Cambrian bedrock. These unconsolidated sediments consist of gravel, sand, silt, and clay deposits. These sediments thicken eastward towards the Delaware River. (Earth Sciences, 1999). The excavations, test pits, and monitoring wells installed during the RFI were not advanced to a depth that encountered bedrock; however, information regarding the artificial fill and upper portion of the underlying unconsolidated sediments was obtained which supports the above findings from the adjacent General Chemical Site.

#### **2.1.2 Local Geology**

The Facility is located within the Coastal Plain Physiographic Province and lies approximately 1 mile east of the Fall Line, which marks the beginning of the Piedmont Physiographic Province. CH2M Hill reported that the site is underlain by three distinct stratigraphic units that include from youngest to oldest:

- Heterogeneous artificial fill of relatively uniform thickness,
- Fluvially-deposited sands, silts and clays, comprising the Pleistocene-Holocene Trenton Gravel, and
- Precambrian age intrusive igneous rocks, which define the bedrock basement.

Much of the subsurface at the Facility consists of artificial fill material. The fill typically ranges from 0 to 7 feet and is underlain by fluvial unconsolidated deposits that extend to either a weathered rock zone (saprolite) or actual bedrock which was encountered at

approximately 16 to 19 ft bgs. The thickness of the alluvial deposits ranged from 25 to 40 ft at the adjacent General Chemical Site. The test pits, soil borings and monitoring wells installed during the RFI did not advance through the alluvial deposits so this could not be confirmed. Bedrock was encountered at depths ranging from 15.8-ft to 54.0-ft at the adjacent General Chemical Site.

During the installation of MW-1 and MW-3, unconsolidated sediments were encountered to termination depths of 19-ft and 16-ft, respectively. A saprolite material (weathered granite) was encountered near the bottom of each well suggesting that bedrock may be present within several feet of the boring completion depth. The sediment thickness underlying SWMU-9 is unknown because soil borings were terminated after encountering native soils that consisted of silt, sand and clay.

## **2.2 HYDROGEOLOGY**

The following subsections discuss the regional and local hydrogeology and incorporate the findings from the four shallow monitoring wells that were installed at the site during the RFI.

### **2.2.1 Regional Hydrogeology**

The principal water-bearing zone consists of the unconsolidated sand and gravel of the Coastal Plain sediments. Interbedded sand and clay may create locally partially confined aquifer conditions at depth. Recharge of the unconsolidated aquifer occurs mainly in the form of precipitation. The water table aquifer generally follows topography and flows from areas of higher elevation to lower elevations. (Earth Sciences, 1999). Groundwater flow is typically to regional discharge points such as the Delaware River.

### **2.2.2 Local Hydrogeology**

Local groundwater flows to the southeast and southwest from the site and discharges into the Delaware River. Groundwater flow within the water table aquifer at the site is controlled by the site's proximity to the Delaware River and groundwater flows through the underlying porous media. Local topographic features result in flow from potentiometric highs to

potentiometric lows; this groundwater flow behavior has been observed at both the Honeywell and adjoining General Chemical site. It has been demonstrated that the Delaware River is a discharge zone for the uppermost bedrock, creating an upward hydraulic gradient between the bedrock and unconsolidated aquifers (Earth Sciences, 1999). Bedrock wells were not installed during the RFI so no data is available to confirm this finding on the Honeywell site. According to the Earth Sciences RFI Work Plan (December, 2000), a tidal study conducted by CH2M Hill at AOC 2 yielded minimal influence of the tidal fluctuations on the water table.

The water table was encountered between 7 and 12.5 feet below ground surface (bgs) in the four shallow groundwater monitoring wells installed on the Honeywell site. Shallow water level data was collected during two synoptic events that allowed data to be collected from both the Honeywell and General Chemical sites. Additional data was collected during site-specific groundwater sampling event and confirms that shallow groundwater flows to the southeast and southwest under a gradient of 0.05 ft/ft. Groundwater flow on the Honeywell agrees favorably with the General Chemical groundwater flow findings.

The sole source of metered water at the site is derived from General Chemical who in turn receives water from the Chester Water Authority in Chester, PA. No production or potable wells were detected from a 0.5-mile radius database search conducted by DNREC and PADEP. Borings advanced within SWMU-9, located in the South Plant, encountered evidence of free-phase petroleum in one boring (SM09-SB04-01) and dissolved phase petroleum product was also encountered along the northern edge of the unit in one boring (SM09-GW03). There is no known source of petroleum in the area of SWMU-9, therefore it is believed that this petroleum product is from an offsite source.

## **2.3 SURFACE WATER**

The North Plant is located within approximately 3000 ft of the Delaware River and SWMU-9 is located adjacent to the Delaware River. The Delaware River, which is tidally-influenced, flows from north to south along the eastern side of the South Plant. Monitoring wells were not installed in the SWMU 9 area during the RFI so the extent of tidal influence from the Delaware has not been confirmed at this time. However, as indicated in Section 2.2.2, work

performed at the adjacent General Chemical Site suggest tidal influence is minimal at the Site. Surface water quality was evaluated during the RFI by collecting three surface water samples from ponded surface water runoff during a significant runoff event on June 4, 2003. Surface water and non-contact cooling water at the Facility is discharged to the Delaware River through a National Pollutant Discharge Elimination System (NPDES)-permitted outfall channel that is located adjacent to SWMU 9. Specifically, the channel extends along the western perimeter of SWMU 9 and terminates approximately 1,800 feet from the north plant. The outfall is maintained and monitored by General Chemical.



### 3.0 SWMU DESCRIPTIONS

This section of the report discusses the existing information available for each of the eight SWMUs that were assessed during the RFI, the procedures used to evaluate the nature and extent of each SWMU, and the revised description of each unit. With the exception of SWMU 9, no previous investigations were conducted at any of the SWMUs at the Honeywell Facility. The previous investigations conducted at SWMU 9 are discussed in Section 2.4.1.1 of the RFI Work Plan.

#### 3.1 EXISTING DATA ASSESSMENTS

Historical information (including excavation dimensions) discussed in the following sections was obtained either from the SWMU information sheets submitted to EPA in 1986 or from interviews with site personnel. Therefore, the exact boundaries and configuration of the SWMUs were unknown prior to start of the RFI and was part of the scope-of-work for the RFI. With the exception of SWMU 9, no soil or groundwater data were available to evaluate the potential impact of each SWMU on site soils or groundwater and therefore, collection of analytical data for soil and groundwater was part of the scope-of-work for the RFI.

#### 3.2 SOLID WASTE MANAGEMENT UNIT DESCRIPTIONS

The following sections provide descriptions of the eight individual SWMUs that were evaluated as part of the RFI. Table 1 summarizes the available historic information for each SWMU based on record searches, aerial photograph reviews, and interviews with current and former site personnel. The revised SWMU descriptions based on the RFI findings are also presented on the table. Figure 3 displays the RFI derived SWMU locations and configuration, monitoring well locations, and the RFI sample locations.

The information collected during the RFI did not significantly alter the Site Conceptual Model (SCM) for SWMU 9 and the North Plant. Accordingly, modifications to the SCM are not deemed to be necessary. The SCM will be modified once the sources of soil and groundwater impact, exposure pathways, and potential receptors for SWMU-related hazardous constituents are further delineated.

### **3.3 SWMU 9 – SOLID WASTE IMPOUNDMENT/PILE**

SWMU 9 is a former settling pond surrounded by a bulkhead that is situated on the Delaware River on what is being referred to as Parcel 1 (Figure 2). The area was used for dewatering of alum mud from 1966 to the late 1980's, though more recent construction debris and process related equipment and material placement were noted during the site reconnaissance in March 2000 and during the RFI. Review of aerial photography of the SWMU revealed that an impoundment was historically located in this area as early as 1965. Reportedly, the alum mud was placed in the impoundment area for dewatering. Once the alum mud was dewatered, it was removed and stockpiled adjacent to the impoundment. Over the years, as space for stockpiling dewatered material became limited, the impoundment itself was used for storage. The stockpiling of the waste material has resulted in three distinct topographic intervals, which are referred to in this report as the upper, middle and lower levels. Refer to the RFI Work Plan for a detailed history of SWMU 9.

The SWMU reportedly contains over 350,000 tons of gypsum, iron oxide mud, and alum mud, and encompasses approximately 16 acres. The pile is bounded on the northern, western, and eastern sides by a chain link fence and on the southern side by a wooden sheet pile along the Delaware River, restricting access to the SWMU. The SWMU is covered with significant vegetation; however, several areas of erosion were observed during the RFI. The most significant erosional areas are located on the northeast and northwest sides of the unit.

#### **3.3.1 Previous Investigations**

In December 1974, the Facility considered selling the stockpiled material for use as road bedding. Exploratory soil borings were installed through the alum mud stockpile to assess the physical and chemical composition of the material. Samples of the stockpiled material were collected and submitted for metals analysis. Analytical results of the samples collected revealed lead concentrations in the stockpile ranging from 15.6 milligrams per kilogram (mg/kg) to 5,810 mg/kg. Additionally, samples with the highest metals concentrations were analyzed for leaching potential of metals using a water extraction method. The results from the leaching test indicated lead concentration of 1.3 to 4.8 mg/l. In the late 1980's, under

guidance from DNREC, a vegetative cover was installed at SWMU 9 for erosion control. In 1994, a *Storm Water Plan* was prepared for the site outlining inspection and monitoring requirements for the vegetative cover.

### **3.3.2 Investigation Description**

A total of 18 borings were advanced through the pile to assess subsurface conditions. The pile was divided into six sectors by laterally bisecting the pile and then further dividing the pile into thirds resulting in six sectors. Figure 4 presents the sampling locations and sampling strategy that was used to characterize the pile.

Three borings were advanced within each sector. The 0-1 foot depth of these three borings were composited into one sample, the 1-15 foot interval of these three borings were composited into a second sample, and the 15 to native material interval of these three borings were composited into a third sample. This typically resulted in three interval specific samples per sector; however, only two samples were collected on the lower level (Sector 5 and 6) because native material was encountered within 15 feet of ground surface.

Sampling was performed in accordance with the procedures presented in the Field Sampling Plan (FSP), which is part of the site Workplan. Table 2 presents a summary of all samples collected during the RFI and the analyses performed on each sample. Table 3 presents the field IDs for each of the samples collected in SWMU 9 and the analysis performed on each of these samples plus quality assurance/quality control (QA/QC) samples collected during the RFI.

Three groundwater samples were collected from soil borings augered through the unit; two groundwater samples were collected from the lower level, closest to the Delaware River and the third groundwater sample was collected upgradient of the impoundment near the southwest edge of the unit (Figure 3). The samples are identified as SM09-GW01 through SM09-GW03 and were collected from the soil boring using a small diameter, disposable, plastic bailer. Groundwater samples collected at SWMU 9 were analyzed for total and dissolved metals. Table 2 presents a summary of all samples collected during the RFI and

the analyses performed on each sample. Table 3 presents the field IDs for each of the samples collected in SWMU 9 and the analysis performed on each of these samples.

Three surface water samples were collected within SWMU 9; two samples were collected from the middle level and one sample was collected from the center of the lower level (Figure 3). Specifically, Sample SM09-Runoff-01 was collected from the center of the lower level of SWMU 9, SWMU 9 SM09-Runoff-02 was collected from the center of the middle level of SWMU 9, and SM09-Runoff-03 was collected from the road to the middle level beneath the Western slope. Table 2 presents a summary of all samples collected during the RFI and the analyses performed on each sample. Table 3 presents the field IDs for each of the samples collected in SWMU 9 and the analysis performed on each of these samples.

### **3.3.3 Revised SWMU Description**

The stockpile consists of three topographic levels referred to as the upper level with a thickness of approximately 14 to 20 feet, the middle level, which varies in thickness from 16 to 18 feet, and the lower level, which varies in thickness from 3 to 22 feet. Overall the thickness of the pile varies from a minimum of 12 feet on the lower level to over 57 feet on the upper level. RFI borings indicated that the depth at which native materials were encountered varied by up to 10 feet locally; however, the composition of the material encountered within the pile was fairly uniform and consisted mainly of basic alum mud.

Figure 5 presents three cross-sections of SWMU 9, which presents these three intervals and the location of each boring in plan view and select borings in cross-section. As indicated on Figure 5, the pile consists of gypsum, iron oxide mud, and alum mud. Lithologic boring logs for SWMU 9 are presented in Appendix A.

The investigation findings do not alter the size of the unit or the physical composition of the material; however, the thickness of the material is more thoroughly documented. Accordingly, SWMU 9 is a 16 acre waste pile that consists of gypsum, iron oxide mud, and alum mud with three distinct topographic intervals which have been defined herein as the upper, middle, and lower levels. The pile thickness varies from 12 to 57 feet based on the 18 borings advanced during the RFI.

### **3.4 SWMU 13 – LANDFILL AREA I**

SWMU 13 was originally defined as a 200-ft long by 10-ft wide by 15-ft deep excavation in which drums were disposed. The drum contents were reportedly drained into the excavation prior to disposal. According to plant personnel, the drums contained various organic and inorganic acids, stripper solutions, and chlorinated solvents.

The SWMU was investigated using a combination of non-intrusive and intrusive techniques. The area was first assessed using a combination of geophysical techniques including ground penetrating radar (GPR) and electromagnetics (EM). The geophysical reports are presented as Appendix B. The intrusive portion of the investigation included excavation of seven Test Pits to define the extent of the SWMU and to further investigate “targets” identified using the geophysical techniques.

Two soil samples were collected in Test Pits 5 and 7, where the highest Photoionization Detector (PID) detections were encountered, to assess the quality of soil in SWMU 13. The soil sample locations are presented on Figure 3. Additionally, two Geoprobe™ groundwater samples were collected from near Test Pits 5 and 7 at a depth of 20-ft to assess groundwater quality in SWMU 13. The groundwater sample locations are presented on Figure 3.

Sampling was performed in accordance with the procedures presented in the Field Sampling Plan (FSP), which is part of the site Workplan. Table 2 presents a summary of all samples collected during the RFI and the analyses performed on each sample. Table 3 presents the field IDs for each of the samples collected in SWMU 13 and the analysis performed on each of these samples. Test Pit lithologic logs are presented in Appendix C.

SWMU 13 was defined by the limit of the disturbed material identified by the geophysical investigation and PID readings because the SWMU materials were not significantly different from the surrounding media (silt) with the exception of some occasional debris. Based on the above RFI findings, SWMU 13 is 225-ft long by 35-ft wide by 11-ft deep (Figure 3).

### **3.5 SWMU 14 – LANDFILL AREA II**

SWMU 14 was originally defined as a 40-ft long by 40-ft wide by 10-ft deep excavation in which waste cuprous chloride and cupric chloride were disposed. Construction debris from the demolition of Building 12 was reportedly disposed in the excavation.

The SWMU was investigated using a combination of non-intrusive and intrusive techniques. The area was first assessed using a combination of geophysical techniques including ground penetrating radar (GPR) and electromagnetics (EM). The geophysical reports are presented as Appendix B.

The intrusive portion of the investigation included excavation of six test pits. The material encountered included construction debris that consisted primarily of bricks; some construction debris contained residual cuprous chloride and cupric chloride waste.

Two soil samples were collected from Test Pits where evidence of cuprous chloride, cupric chloride waste and/or elevated PID readings were encountered. Two groundwater samples were collected from these test pits to assess the quality of soil and groundwater at this SWMU (Figure 3). Sampling was performed in accordance with the procedures presented in the Field Sampling Plan (FSP), which is part of the site Workplan. Table 2 presents a summary of all samples collected during the RFI and the analyses performed on each sample. Table 3 presents the field IDs for each of the samples collected in SWMU 13 and the analysis performed on each of these samples. Test Pit lithologic logs are presented in Appendix C.

The extent of SWMU 14 was defined by the extent to which construction debris consisting primarily of bricks with evidence of cuprous chloride and cupric chloride waste were present. Based on the RFI findings, SWMU 14 is estimated to be 140-ft long by 95-ft wide by 5-ft deep (Figure 3). The western perimeter of SWMU 14 is an estimated boundary and may extend further into General Chemical property than indicated on Figure 3. The extent of the test pit excavation in the westward direction was limited due to Honeywell concern regarding unknown utilities as the excavation proceeded onto the General Chemical property.

### **3.6 SWMU 15 – LANDFILL AREA III**

SWMU 15 was originally defined as a 200-ft long by 50-ft wide by 10-ft deep excavation in which various stripper solutions, oxidizers, organic acids, and phosphorous compounds were disposed. The excavation was backfilled in 1972 and is currently heavily covered with construction/demolition debris. As a result, the non-intrusive techniques of investigation and Geoprobe<sup>TM</sup> soil sampling that were originally proposed were not possible. A backhoe was used to clear paths through the debris piles and to excavate test pits to permit the collection of soil samples from this SWMU.

A total of eight test pits were excavated during the RFI and the primary SWMU contents consisted of abundant demolition/construction debris consisting primarily of asphalt, bricks, concrete, glass and wood.

Three soil samples were collected from test pits excavated during the RFI (Figure 3). Samples were obtained from the test pits that exhibited the highest PID results, contained slag or other obvious waste or where staining or color suggested a possible impact. Three Geoprobe<sup>TM</sup> groundwater samples were collected near the test pits where soil samples were collected. The groundwater samples were collected at depths ranging from 8 to 20 ft below ground surface (ft bgs) to assess groundwater quality at SWMU 15. The groundwater sample locations are presented on Figure 3.

Sampling was performed in accordance with the procedures presented in the Field Sampling Plan (FSP), which is part of the site Workplan. Table 2 presents a summary of all samples collected during the RFI and the analyses performed on each sample. Table 3 presents the field IDs for each of the samples collected in SWMU 15 and the analysis performed on each of these samples. Test Pit lithologic logs are presented in Appendix C.

The extent of SWMU 15 was defined by the absence of waste (demolition/construction debris) in the test pits. The RFI findings indicated that SWMU 15 is far larger than previous believed with dimensions of approximately 250-ft long by 150-ft wide by 5-ft deep (Figure 3).

### **3.7 SWMU 17 – LANDFILL AREA V**

SWMU 17 was originally defined as a 6-ft long by 4-ft wide by 1-ft deep former stone-filled surface trench that was used for disposal of laboratory samples. Samples were reportedly poured from their containers into the trench. Currently the SWMU is located under an asphalt pad in which confined space entry training is performed within an AST that occupies the pad.

The SWMU was investigated using a combination of non-intrusive and intrusive techniques. The area was first assessed using a combination of geophysical techniques including ground penetrating radar (GPR) and electromagnetics (EM). The geophysical reports are presented in Appendix B. The intrusive portion of the investigation included 17 Geoprobe™ soil borings that were advanced within the footprint of SWMU 17 and indicated that the primary contents of the SWMU were abundant glass fragments; the SWMU was defined largely by elevated PID readings.

One soil and one groundwater sample was collected to assess soil and groundwater quality at SWMU 17 at the locations presented on Figure 3. The soil and groundwater sampling locations were selected based on the location of the highest PID readings. Sampling was performed in accordance with the procedures presented in the Field Sampling Plan (FSP), which is part of the site Workplan. Table 2 presents a summary of all samples collected during the RFI and the analyses performed on each sample. Table 3 presents the field IDs for each of the samples collected in SWMU 17 and the analysis performed on each of these samples. Test Pit lithologic logs are presented in Appendix C.

The extent of the SWMU 17 was defined based on elevated PID results, abundant glass fragments, and where native materials were encountered. Based on the RFI findings, SWMU 17 is actually 44-ft long by 30-ft wide by 10-ft deep (Figure 3).

### **3.8 SWMU 18 – LANDFILL AREA VI**

SWMU 18 was originally defined as a 12-ft long by 6-ft wide by 4-ft deep excavation in which pesticide-related wastes (i.e., acetyl chloride, methoxychlor, and monochlorobenzene)



were disposed. The excavation was reportedly lined with plastic, and the materials disposed in glass carboys or steel drums. The excavation was backfilled with soil and capped with asphalt in 1978.

The SWMU was investigated using a combination of non-intrusive and intrusive techniques. The area was first assessed using a combination of geophysical techniques including ground penetrating radar (GPR) and electromagnetics (EM). The geophysical reports are presented as Appendix B. The intrusive portion of the investigation included 12 test pits. The materials encountered within the SWMU included several glass and plastic bottles containing liquids and impacted soil. No evidence of a plastic liner was found in the excavation. Several glass and plastic bottles containing liquids were found at a depth of 2.5-ft in Test Pits 4 and 8.

Two soil samples were collected to assess soil quality from Test Pits 8 and 9. The soil sample locations are presented on Figure 3. One sample was collected near the waste containers and the second was collected nearby to assess the concentration of constituents within the surrounding soil. Three Geoprobe groundwater samples were collected from near the test pits and driven to depths of 12-ft to 16-ft to assess the groundwater quality of SWMU 18 (Figure 3). Sampling was performed in accordance with the procedures presented in the Field Sampling Plan (FSP), which is part of the site Workplan. Table 2 presents a summary of all samples collected during the RFI and the analyses performed on each sample. Table 3 presents the field IDs for each of the samples collected in SWMU 18 and the analysis performed on each of these samples. Test Pit lithologic logs are presented in Appendix C.

The extent of the SWMU 18 was defined based on the absence of waste materials (glass and plastic bottles) and reduction of elevated PID readings. Based on the RFI findings, SWMU 18 is actually 45-ft long by 40-ft wide and 5-ft deep (Figure 3).

### **3.9 SWMU 19 – LANDFILL AREA VII**

SWMU 19 was originally defined as a 50-ft long by 12-ft wide by 10-ft deep excavation in which DDT/TDE mud is buried. It is reported that on several occasions, an unknown material has seeped up through cracks in the asphalt pavement.

The SWMU was investigated using a combination of non-intrusive and intrusive techniques. The area was first assessed using a combination of geophysical techniques including ground penetrating radar (GPR) and electromagnetics (EM). The geophysical reports are presented as Appendix B. The intrusive portion of the investigation included excavation of five test pits. The test pits encountered construction debris and fill material.

Two soil samples were collected from the SWMU; one from Test Pit 3 and one from Test Pit 4 to assess the soil quality of SWMU 19. The soil sample locations and analytical results are presented graphically on Figure 3. One Geoprobe<sup>TM</sup> groundwater sample was collected from near Test Pit SM19-TP-05 at a depth of 12 ft bgs to assess the groundwater quality of SWMU 19. The groundwater sample location is presented on Figure 3. Sampling was performed in accordance with the procedures presented in the Field Sampling Plan (FSP), which is part of the site Workplan. Table 2 presents a summary of all samples collected during the RFI and the analyses performed on each sample. Table 3 presents the field IDs for each of the samples collected in SWMU 19 and the analysis performed on each of these samples. Test Pit lithologic logs are presented in Appendix C.

The limits of the SWMU were defined using the extent of construction debris and PID readings. Based on the results of the RFI, SWMU 19 is defined as a 90-ft long by 25-ft wide by 10-ft deep area (Figure 3).

### **3.10 SWMU 20 – LANDFILL AREA VIII**

SWMU 20 was originally defined as a 90-ft long by 90-ft wide by 8-ft deep former cooling pond that was drained and backfilled in the late 1970's to early 1980's. Prior to elimination of the cooling pond, leaking boron trifluoride and iodine pentafluoride cylinders were placed in the pond to control gaseous emissions. Plant personnel report that cylinders were often removed from the pond once they were emptied. It is unknown whether any cylinders were left in the pond.

In the mid 1980's, during construction of the new tube trailer loading area, the backfill material in the pond was excavated due to its poor quality. Material from SWMU 9 was

reportedly brought in to fill the excavation prior to constructing the concrete pad. Plant personnel report that no cylinders were identified in the excavation during the project.

The SWMU was investigated using a combination of non-intrusive and intrusive techniques. The area was first assessed using a combination of geophysical techniques including ground penetrating radar (GPR) and electromagnetics (EM). The geophysical reports are presented as Appendix B. The intrusive portion of the investigation included excavation of five test pits; three within the unit and two adjacent to the unit. Excavations could not be conducted in the majority of the SWMU due to hard subsurface conditions and buried concrete pads.

Two soil samples were collected from the test pits along the edge of the concrete to assess soil quality on the perimeter of the SWMU and were identified as SM20-TP02-01 and SM20-TP03-01. The soil sampling locations for SWMU 20 are presented on Figure 3. Two Geoprobe™ groundwater samples were collected from near the test pits at depths of 10 ft bgs and 15 ft bgs to assess groundwater quality at SWMU 20. The groundwater sampling locations are presented on Figure 3. Sampling was performed in accordance with the procedures presented in the Field Sampling Plan (FSP), which is part of the site Workplan. Table 2 presents a summary of all samples collected during the RFI and the analyses performed on each sample. Table 3 presents the field IDs for each of the samples collected in SWMU 20 and the analysis performed on each of these samples. Test Pit lithologic logs are presented in Appendix C.

The delineation of SWMU 20 was limited by the presence of hard subsurface materials and large concrete pads; based on these limited excavations, SWMU 20 is 60-ft long by 50-ft wide by 6-feet deep (Figure 3).

### **3.11 SITEWIDE GROUNDWATER MONITORING WELL INSTALLATION**

Although not specifically installed to assess SWMU groundwater quality, four monitoring wells, identified as MW-1 through MW-4, were installed to assess background and downgradient groundwater quality within the shallow water table aquifer. Each of the monitoring wells were advanced using the hollow stem auger (HSA) drilling technique and were installed with 10 foot screens within the first zone of saturation encountered. The wells

were installed in accordance with the procedures presented in the Field Sampling Plan, which is part of the approved Workplan and are presented on Figure 3. Table 4 presents the monitoring well specifications for the four shallow monitoring wells. Monitoring well lithologic and construction logs are presented in Appendix D.

MW-1 is located in the eastern corner of the site in a parking lot and is located just downgradient of SWMU 13. MW-2 is located in the northwestern corner of the site at the upgradient edge of SWMU-15 and serves as an upgradient well. MW-3 is located along the western edge of the site perimeter along the railroad tracks and serves as an upgradient well. MW-4 is located along Philadelphia Pike near the administration building and serves as a downgradient monitoring well.

## **4.0 SITE INVESTIGATION ANALYTICAL RESULTS FOR SOIL**

A total of 68 test pits and soil borings were advanced during the RFI to characterize the soil quality at the Facility. From these test pits and soil borings, 34 soil samples and 11 quality assurance/quality control (QA/QC) samples were collected. Table 2 provides a summary of samples and matrices that were sampled within the 8 SWMUs during the RFI. Table 3 provides the sampling plan and quality assurance samples for the RFI.

The following sections present the analytical results of the soil sampling conducted as part of the RFI. The results are presented on a sitewide basis to develop an overview of soil quality and on a SWMU specific basis to focus on individual SWMU soil quality.

### **4.1 SOIL CLASSIFICATION**

The lithology underlying the Facility was determined by excavating 68 test pits and logging soil borings. The soil consists of an artificial fill material comprised of silt with little to some sand with trace to abundant demolition/construction material. This material consists primarily of bricks, concrete, gravel, slag, wood and glass. The fill material ranged in depth from 0 to 7-ft bgs. Beneath the fill material, a layer of grayish, green, tan to rose silt with trace to some clay was encountered. The silt ranged from moderately firm to firm. At MW-1 and MW-3, weathered rock was encountered at a depth of 15-ft to 16-ft respectively. This saprolite was white to dark gray and black, silt with little fine sand and abundant mica, suggesting a granitic source material. Test pit lithologic logs are presented as Appendix C.

The material that comprises SWMU 9 consists of gypsum, iron oxide mud, and alum mud that is a beige to light brown silt with fine to coarse-grained sand and fine gravel. Layers of this mud have consolidated into a very hard sandstone-like material. There are also layers of purplish red oxidized silt present in several borings; however, no apparent placement pattern was observed for this material. Figure 5 presents three cross-sectional views of SWMU 9. Soil boring lithologic logs for SWMU 9 are presented in Appendix A.

## **4.2 ANALYTICAL TESTING RESULTS FOR SOIL QUALITY ASSESSMENT**

A total of 34 soil samples plus 11 QA/QC samples were collected during the RFI to assess soil quality within the eight SWMUs identified in the RFI Work Plan. Appendix E presents the RFI soil sampling results and provides a comparison to the Human Health Residential RBC (Residential RBC), Soil to Groundwater Migration Soil Screening Levels (SSLs) utilizing the Dilution Attenuation Factor 20 (DAF 20), Ingestion of VOCs, Human Health Industrial RBC (Industrial RBC) and Ecological Criteria to determine if detected constituents exceed the action levels. Table 5 presents a statistical analysis of detected constituents in soil, the number of detections above the limit of quantitation, their minimum and maximum detections, and the average detection levels for the site.

### **4.2.1 Summary of Volatile Constituent Detections for Soil**

A total of 29 individual volatile organic constituents were detected above the limit of quantitation in the soil samples collected during the RFI. Nineteen VOCs exceeded the Residential RBC; however, only four VOCs (benzene, carbon tetrachloride, tetrachloroethylene (PCE) and trichloroethylene (TCE)) exceeded the Industrial RBC. Chlorobenzene was the only volatile organic constituent in the RFI soil samples that exceeded the Ecological criteria.

Acetone, chloroform, PCE and TCE were the most commonly detected constituents in RFI soil samples.

- Acetone was detected at concentrations ranging from 11 micrograms/kilogram (ug/kg) to 96 ug/kg; however, detected acetone did not exceed the Residential RBC, Industrial RBC or Ecological criteria.
- Chloroform was detected at concentrations ranging from 1.6 ug/kg to 63,000 ug/kg and exceeded the Residential RBC in eight of the 10 samples in which it was detected. The chloroform Industrial RBC and Ecological criteria were not exceeded.
- PCE was detected at concentrations ranging from 2.1 ug/kg to 2,100,000 ug/kg. PCE exceeded the Residential RBC in eight of the 13 samples in which it was detected. PCE exceeded the Industrial RBC at two sample locations (SM13-TP07-01 and SM17-GP01-01) but did not exceed the Ecological criteria.

- TCE exceeded the Residential RBC in eight of the 10 samples in which it was detected; however, only one sample (SM17-GP01-01) exceeded the Industrial RBC. The TCE concentrations did not exceed the Ecological criteria in samples collected during the RFI.

#### **4.2.2 Summary of Semivolatile Constituent Detections for Soil**

A total of 45 individual semivolatile constituents were detected above the limit of quantitation in the soil samples collected during the RFI. Twenty detected SVOC constituents exceeded the Residential RBC; however, only four SVOCs (1,3-Dinitrobenzene, benzo(a)pyrene, dibenzo(a,h)anthracene and hexachlorobenzene) exceeded the Industrial RBC. Semivolatile constituents did not exceed the Ecological criteria for soil in samples collected during the RFI.

Benzo(k)fluoranthene, chrysene, fluoranthene and pyrene were the most commonly detected constituents; however, neither the Human Health nor Ecological criteria were exceeded for any of these constituents. Benzo(a)pyrene was detected above the limit of quantitation at seven sample locations and ranged in concentration from 78 ug/kg to 2,900 ug/kg. The Residential RBC criteria for benzo(a)pyrene was exceeded in six of the seven samples collected from SWMUs 14, 15, and 18. The Industrial RBC was exceeded in three samples (SM14-TP03-01, SM14-TP06-01 and SM15-TP01-01). Ecological criteria has not been established for benzo(a)pyrene.

#### **4.2.3 Summary of Pesticide Detections for Soil**

A total of six individual pesticide constituents were detected above the limit of quantitation in the soil samples collected during the RFI. The Residential RBC was exceeded for each of the six pesticides detected in soil and the Industrial RBC was exceeded for four of the six detected pesticides. Ecological criteria have not been established for the six pesticides detected during the RFI.

The most commonly detected pesticide constituents were p,p'-DDD, p,p'-DDE and p,p'-DDT.

- p,p'-DDD was detected in 11 samples at concentrations ranging from 5.7 ug/kg to 580,000 ug/kg and exceeded the Residential RBC in five samples (SM14-TP03-01, SM14-TP06-01, SM17-GP01-01, SM18-TP08-01 and SM19-TP04-01) and exceeded the Industrial RBC in three samples (SM17-GP01-01, SM18-TP08-01 and SM19-TP04-01).
- p,p'-DDT was detected in 11 samples in concentrations ranging from 8 ug/kg to 1,400,000 ug/kg and exceeded the Residential RBC in seven samples collected from SWMUs 14, 15, 17, 18, and 19. The p,p'-DDT Industrial RBC was exceeded in four samples (SM14-TP03-01, SM14-TP06-01, SM17-GP01-01 and SM19-TP04-01).
- p,p'-DDE was detected in eight samples at concentrations ranging from 250 ug/kg to 51,000 ug/kg and exceeded the Residential RBC in four samples (SM19-TP04-01, SM18-TP08-01, SM14-TP06-01 and SM14-TP03-01). The Industrial RBC was exceeded in one sample (SM19-TP04-01).

#### **4.2.4 Summary of Metals Detections for Soil**

A total of 25 individual inorganic constituents were detected above the limit of quantitation in the soil samples collected during the RFI. Fifteen of the 25 inorganic constituents detected exceeded the Residential RBC, seven inorganics exceeded the Industrial RBC and 19 metals exceeded the Ecological criteria.

Barium, chromium, copper, lead, vanadium and zinc were the most commonly detected inorganic constituents. The following section summarizes the overall detection frequency and range of concentration for these constituents as well as aluminum, arsenic, iron, mercury and selenium:

- Aluminum was detected in 26 soil samples at concentrations ranging from 3,310 mg/kg to 130,000 mg/kg. The Residential RBC for aluminum was exceeded at 22 of the 26 samples. The Ecological criteria was exceeded at each of the 26 sample locations where the constituent was detected; however, the Industrial RBC was only exceeded at one sample location (SM09-SB04-01).
- Arsenic was detected in 21 soil samples at concentrations ranging from 4.3 mg/kg to 6,850 mg/kg. Arsenic exceeded the Residential RBC and Industrial RBC in each of the 21 sample locations in which it was detected and exceeded the Ecological criteria in 17 of the 21 sample locations.



- Barium was detected in 30 samples at concentrations ranging from 23.0 mg/kg to 1,060 mg/kg. Barium exceeded the Residential RBC in 20 samples, exceeded the Industrial RBC in three samples and exceeded the Ecological criteria in five samples.
- Chromium was detected in 30 soil samples at concentrations ranging from 6.8 mg/kg to 184 mg/kg. Chromium exceeded both the Residential RBC and Ecological criteria at each sample location where this constituent was detected above the limit of quantitation. Chromium did not exceed the Industrial RBC in samples collected during the RFI.
- Copper was detected in 30 samples at concentrations ranging from 5.2 mg/kg to 107,000 mg/kg. Copper exceeded the Residential RBC in nine samples, exceeded the Industrial RBC in four samples and exceeded the Ecological criteria in 18 of the 30 samples.
- Iron was detected in 26 samples at concentrations ranging from 912 mg/kg to 184,000 mg/kg. Iron exceeded the Residential RBC in 23 of the 26 samples and exceeded the Industrial RBC in seven of the 26 samples. The Ecological criteria was exceeded in each of the 26 samples.
- Lead was detected in 30 samples in concentrations ranging from 6.7 mg/kg to 5,410 mg/kg and exceeded the Residential RBC in 9 of the 30 samples and exceeded the Ecological criteria in 25 of the 30 samples.
- Mercury was detected in 27 samples in concentrations ranging from 0.03 mg/kg to 48.2 mg/kg. Mercury exceeded the Residential RBC in 14 of the 27 samples, and exceeded the Ecological criteria in 26 of the 27 samples. The Industrial RBC for mercury was not exceeded in soil samples collected during the RFI.
- Selenium was detected in 21 soil samples in concentrations ranging from 0.84 mg/kg to 271 mg/kg. The Residential RBC was exceeded at 15 of the 21 samples and the Ecological criteria was exceeded in 19 of the 21 samples. The Industrial RBC for selenium was not exceeded in soil samples collected during the RFI.
- Vanadium was detected in 30 samples and exceeded the Ecological criteria in each of the 30 samples; however, the Residential RBC was only exceeded in five of the 30 samples (SM09-SB01-01, SM09-SB03-01, SM09-SB04-01, SM09-SB04-02 and SM09-SB06-01). The Industrial RBC for vanadium was not exceeded in soil samples collected during the RFI.
- Zinc was detected in 30 samples in concentrations ranging from 9.2 mg/kg to 1,670 mg/kg. The Residential RBC was exceeded in three samples and the Ecological criteria was exceeded in 18 of the 30 samples. The Industrial RBC for zinc was not exceeded in soil samples collected during the RFI.

#### **4.2.5 Summary of Herbicide Detections for Soil**

Herbicides were not detected above the limit of quantitation in the soil samples collected during the RFI.

#### **4.2.6 Summary of PCB Detections for Soil**

Two arochlors of PCBs, PCB-1254 and PCB-1260 were detected above the limit of quantitation in two soil samples (SM15-TP01-01 and SM14-TP03-01) collected during the RFI; however, only PCB-1254, which was detected at a concentration of 280 µg/kg, exceeded the Residential RBC. Neither the Industrial RBC nor the Ecological criteria for PCBs were exceeded in soil samples collected during the RFI.

### **4.3 SUMMARY OF SOIL ANALYTICAL RESULTS BY SWMU**

The following section presents the analytical results as they pertain to each of the 8 SWMUs identified in the RFI Work Plan.

Appendix E presents the analytical results for all soil samples collected during the RFI. Table 5 presents a statistical analysis of detected constituents in soil, the number of detections above the limit of quantitation, their minimum and maximum detections, and the average detection levels for the site.

#### **4.3.1 SWMU 9 – Solid Waste Impoundment/Pile**

Three borings were advanced in each sector of the unit and sampled on 5 foot intervals using a splitspoon sampler. A total of 18 borings were advanced to assess soil quality within the six sectors of SWMU 9. The borings were identified as SM09-SB01-01 through SM09-SB06-02, for a total of 16 samples. The pile has three distinct topographic levels, each of which was evaluated with six borings, three borings per sector. The following sections present the analytical results as they pertain to each of the sample intervals assessed during the RFI. Figure 3 presents the locations of all 18 borings and Figures 6a through 6c present the analytical results by depth interval.

#### 4.3.1.1 Upper Sample Interval – 0 to 1 foot

The upper sample interval was collected from the ground surface to 1-foot bgs in each of the six sectors and the analytical data is presented in plan view on Figure 6a. These samples were collected and composited as described in Section 3.3.2 and are identified as SM09-SB01-01 through SM09-SB06-01.

In the upper level of SWMU 9 (Sectors 1 and 2), a total of 15 inorganic constituents were detected above the limit of quantitation.

##### Sector 1

- Four metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB01-01
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	95,500
Chromium	23	4.2	NS	96.8
Iron	2,300	NS	NS	3,690
Vanadium	55	510	NS	81.9

- Six metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB01-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	95,500
Chromium	1	0.4	10	96.8
Iron	NS	NS	200	3,690
Lead	50	500	900	57.1
Mercury	0.3	0.1	30	0.12
Vanadium	2	NS	20	31.7 J

##### Sector 2

- Three metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB02-01
<b>Metals (mg/kg)</b>				
Barium	550	210	NS	263
Chromium	23	4.2	NS	6.8 B
Mercury	NS	NS	1.3	13.7

*Chromium*

2.3

- Six metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB02-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	3,310
Chromium	1	0.4	10	6.8 B
Iron	NS	NS	200	912
Lead	50	500	900	85.7
Mercury	0.3	0.1	30	13.7
Vanadium	2	NS	20	5 B

- There were no exceedances of the Industrial RBC in the upper sample interval (Sectors 1 or 2).

In the middle level of SWMU 9 (Sectors 3 and 4), a total of 16 inorganic constituents were detected above the limit of quantitation.

### Sector 3

- Four metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB03-01
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	95,500
Chromium	23	4.2	NS	92.7
Iron	2,300	NS	NS	6,240
Vanadium	55	510	NS	105

- Six metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB03-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	95,500
Chromium	1	0.4	10	92.7
Iron	NS	NS	200	6,240
Lead	50	500	900	84.5
Mercury	0.3	0.1	30	0.47
Vanadium	2	NS	20	105

#### Sector 4

- Four metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB04-01
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	130,000
Chromium	23	4.2	NS	99.7
Iron	2,300	NS	NS	8,900
Vanadium	55	510	NS	91.5

- Nine metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB04-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	130,000
Chromium	1	0.4	10	99.7
Copper	100	60	100	106
Iron	NS	NS	200	8,900
Lead	50	500	900	205
Mercury	0.3	0.1	30	1
Nickel	30	200	90	80.1
Vanadium	2	NS	20	91.5
Zinc	50	100	100	705

- Aluminum was detected at a concentration of 130,000 mg/kg and was the only constituent to exceed the Industrial RBC of 100,000 mg/kg.

On the lower level of SWMU 9 (Sectors 5 and 6), a total of 23 inorganic constituents were detected above the limit of quantitation.

## Sector 5

- Nine metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB05-01
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	8,710
Antimony	3.1	1.3	NS	5.5 B
Arsenic	0.43	0.026	NS	205
Barium	550	210	NS	319
Chromium	23	4.2	NS	20.9
Iron	2,300	NS	NS	24,500
Mercury	NS	NS	1.3	2.3
Selenium	39	1.9	NS	15.2
Thallium	0.55	0.36	NS	0.52 B

- Arsenic was the only metal to exceed the Industrial RBC of 1.9 mg/kg in Sector 5 and was detected at a concentration of 205 mg/kg.
- Eleven metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB05-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	8,710
Antimony	5	NS	NS	5.5 B
Arsenic	10	60	100	205
Chromium	1	0.4	10	20.9
Copper	100	60	100	89.9
Iron	NS	NS	200	24,500
Lead	50	500	900	238
Mercury	0.3	0.1	30	2.1
Selenium	1	70	100	15.2
Vanadium	2	NS	20	15.9 B
Zinc	50	100	100	141

*Barclay  
p51  
Mass  
guidance  
document*

## Sector 6

- Eleven metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB06-01
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	50,700
Antimony	3.1	1.3	NS	8.2 B
Arsenic	0.43	0.026	NS	700
Barium	550	210	NS	1,060
Cadmium	3.9	2.7	NS	4 B
Chromium	23	4.2	NS	74.7
Iron	2,300	NS	NS	21,500
Mercury	NS	NS	1.3	17.5
Selenium	39	1.9	NS	26
Thallium	0.55	0.36	NS	2.1
Vanadium	55	510	NS	60.9 B

- Arsenic was the only metal detected in Sector 6 that exceeded the Industrial RBC of 1.9 mg/kg and was detected at a concentration of 324 mg/kg.
- Thirteen metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB06-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	50,700
Antimony	5	NS	NS	8.2 B
Arsenic	10	60	100	700
Barium	500	NS	3,000	1,060
Chromium	1	0.4	10	74.7
Copper	100	60	100	229
Iron	NS	NS	200	21,500
Lead	50	500	900	969
Mercury	0.3	0.1	30	17.5
Selenium	1	70	100	26
Thallium	1	NS	NS	2.1
Vanadium	2	NS	20	60.9 B
Zinc	50	100	100	951

### Summary of the 0 to 1-ft. interval

- Arsenic was only detected above the limit of quantitation in the lower level samples (SM09-SB05-01 and SM09-SB06-01); all three soil screening criteria were exceeded at this level of the unit within the 0 to 1-ft. interval.
- Chromium was detected above the limit of quantitation and exceeded both the Residential RBC and the Ecological criteria in all six samples collected within the 0 to 1-ft. interval.
- Mercury was detected above the limit of quantitation in each of the six samples collected within the 0 to 1 foot interval. The Residential RBC was exceeded in three of the six sample locations (SM09-SB01-01, SM09-SB05-01 and SM09-SB06-01) and the Ecological criteria was exceeded in each of the sample locations. Analytical results for soil collected from the 0 to 1 foot interval are presented in plan view on Figure 6a. All soil analytical detections are presented in Appendix E.

#### 4.3.1.2 Middle Sample Interval – 1 to 15-ft.

The middle sample interval was collected from 1-ft. to 15-ft. bgs in each of the six sectors. These samples were collected and composited as described in Section 3.3.2 and are identified as SM09-SB01-02 through SM09-SB06-02. The analytical data for the 1 to 15-ft. interval is presented in plan view on Figure 6b.

Twenty different metal constituents were detected above the limit of quantitation from the 1 to 15 foot interval of the upper level. A duplicate sample was collected at SM09-SB01-02 (SM09-SB01-02A) and yielded similar results

#### Sector 1

- Seven metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB01-02
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	17,400
Barium	550	210	NS	267
Chromium	23	4.2	NS	25.3
Iron	2,300	NS	NS	15,500
Mercury	NS	NS	1.3	4



Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB01-02
Selenium	39	1.9	NS	7
Thallium	0.55	0.36	NS	0.59 B

- Nine metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB01-02
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	17,400
Chromium	1	0.4	10	25.3
Copper	100	60	100	97.1
Iron	NS	NS	200	15,500
Lead	50	500	900	347
Mercury	0.3	0.1	30	4
Selenium	1	70	100	7
Thallium	1	NS	NS	20.7 B
Vanadium	2	NS	20	173

## Sector 2

- Five metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB02-02
<b>Metals (mg/kg)</b>				
Barium	550	210	NS	360
Chromium	23	4.2	NS	7.2 B
Mercury	NS	NS	1.3	5.4
Silver	39	3.1	NS	3.6 B
Thallium	0.55	0.36	NS	0.79 B

- Seven metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB02-02
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	5,280
Chromium	1	0.4	10	7.2 B
Iron	NS	NS	200	1,200
Lead	50	500	900	95.6

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB02-02
Mercury	0.3	0.1	30	5.4
Silver	2	NS	50	3.6 B
Vanadium	2	NS	20	8.8 B

- There were no exceedances of the Industrial RBC in the upper sample interval in the upper level (Sectors 1 and 2).

On the middle level of SWMU 9 (Sectors 3 and 4), a total of 21 metals were detected above the limit of quantitation.

### Sector 3

- Nine metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB03-02
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	24,900
Arsenic	0.43	0.026	NS	47.1
Barium	550	210	NS	303
Cadmium	3.9	2.7	NS	3.3 B
Chromium	23	4.2	NS	36.4
Copper	310	1,100	NS	316
Iron	2,300	NS	NS	93,200
Selenium	39	1.9	NS	129
Thallium	0.55	0.36	NS	2

- Arsenic exceeded the Industrial RBC of 1.9 mg/kg and iron, detected at a concentration of 93,200 mg/kg exceeded the Industrial RBC of 31,000 mg/kg.
- Thirteen metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB03-02
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	24,900
Arsenic	10	60	100	47.1
Chromium	1	0.4	10	36.4

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB03-02
<b>Metals continued (mg/kg)</b>				
Cobalt	20	NS	1,000	83.6
Copper	100	60	100	316
Iron	NS	NS	200	93,200
Lead	50	500	900	338
Mercury	0.3	0.1	30	0.59
Selenium	1	70	100	129
Silver	2	NS	50	2.5 B
Thallium	1	NS	NS	2
Vanadium	2	NS	20	23.3 B
Zinc	50	100	100	499

#### Sector 4

- Four metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB04-02
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	81,000
Chromium	23	4.2	NS	96.2
Iron	2,300	NS	NS	5,920
Vanadium	55	510	NS	77

- Seven metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB04-02
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	81,000
Chromium	1	0.4	10	96.2
Iron	NS	NS	200	5,920
Lead	50	500	900	57.3
Mercury	0.3	0.1	30	0.72
Vanadium	2	NS	20	77
Zinc	50	100	100	85.4

On the lower level (Sectors 5 and 6), a total of 23 metals were detected above the limit of quantitation.

## Sector 5

- Six metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB05-02
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	30,200
Arsenic	0.14	0.026	NS	16.7
Chromium	23	4.2	NS	29.9
Iron	2,300	NS	NS	13,000
Mercury	NS	NS	1.3	2.1
Selenium	39	1.9	NS	7.8

- Arsenic was the only metal in Sector 5 to exceed the Industrial RBC and was detected at a concentration of 16.7 mg/kg. A duplicate sample (SM09-SB05-02A) was collected from SM09-SB05-02 and yielded similar results.
- Eight metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB05-02
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	30,200
Arsenic	10	60	100	16.7
Chromium	1	0.4	10	29.9
Iron	NS	NS	200	13,000
Lead	50	500	900	93.2
Mercury	0.3	0.1	30	2.1
Selenium	1	70	100	7.8
Vanadium	2	NS	20	27.1

## Sector 6

- Thirteen metals exceeded the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB06-02
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	17,200
Antimony	3.1	1.3	NS	21.8 B
Arsenic	0.14	0.026	NS	324
Barium	550	210	NS	607

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB06-02
<b>Metals continued (mg/kg)</b>				
Cadmium	3.9	2.7	NS	4 B
Chromium	23	4.2	NS	40.1
Copper	310	1,100	NS	521
Iron	2,300	NS	NS	97,200
Mercury	NS	NS	1.3	19.9
Selenium	39	1.9	NS	117
Silver	39	3.1	NS	3.2 B
Thallium	0.55	0.36	NS	3.6
Zinc	2,300	1,400	NS	1,460

- Arsenic, detected at a concentration of 324 mg/kg, and iron, detected at a concentration of 97,200 mg/kg, both exceeded the Industrial RBC of 31,000 mg/kg.
- Fifteen metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB06-02
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	17,200
Antimony	5	NS	NS	21.8 B
Arsenic	10	60	100	324
Barium	500	NS	3,000	607
Chromium	1	0.4	10	40.1
Cobalt	20	NS	1,000	60.3
Copper	100	60	100	521
Iron	NS	NS	200	97,200
Lead	50	500	900	2,010
Mercury	0.3	0.1	30	19.9
Selenium	1	70	100	117
Silver	2	NS	50	3.2 B
Thallium	1	NS	NS	3.6
Vanadium	2	NS	20	37.6 B
Zinc	50	100	100	1,460

### **Summary of the 1 to 15-ft. interval**

- Arsenic was detected above the limit of quantitation in three of the six samples (SM09-SB03-02, SM09-SB05-02 and SM09-SB06-02) collected during the RFI investigation and exceeded all three soil screening criteria in those three samples.
- Chromium exceeded both the Residential RBC and Ecological criteria in each of the six samples collected from the 1 to 15-ft. interval.
- Mercury exceeded the Residential RBC and Ecological criteria in five of the six samples collected from this interval.

Within the 1 to 15-ft. interval, the Industrial RBC was exceeded in Sectors 3, 5 and 6. It was observed that these exceedances appear to correlate with the presence of a purplish red, oxidized silt interval. This interval may explain the elevated concentrations of arsenic and iron in samples detected from Sectors 3, 5 and 6. Soil analytical results from the 1 to 15-ft. interval are presented in plan view on Figure 6b. All soil analytical detections are presented in Appendix E.

#### **4.3.1.3 Lower Sample Interval – 15-ft. to Native**

The lower sample interval was collected from 15-ft to the depth where native material was encountered in each of the six sectors. These samples were collected and composited as described in Section 3.3.2 and are identified as SM09-SB01-03 through SM09-SB04-03. The analytical data for the 15-ft. to native interval is presented in plan view on Figure 6c.

Twenty-one inorganic constituents were detected in samples collected from the upper level (Sectors 1 and 2) of SWMU 9.

## Sector 1

- Ten metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB01-03
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	31,200
Cadmium	3.9	2.7	NS	7.9
Chromium	23	4.2	NS	33.9
Copper	310	1,100	NS	6,280
Iron	2,300	NS	NS	40,900
Mercury	NS	NS	1.3	4.5
Selenium	39	1.9	NS	9.9
Silver	39	3.1	NS	5.1 B
Thallium	0.55	0.36	NS	16.1
Zinc	2,300	1,400	NS	1,670

- Arsenic, copper, iron, and thallium exceeded the Industrial RBC with Arsenic detected at a concentration of 743 mg/kg, copper was detected at a concentration of 6,280 mg/kg, iron was detected at a concentration of 40,900 mg/kg, and thallium was detected at a concentration of 16.1 mg/kg.
- Fifteen metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB01-03
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	31,200
Antimony	5	NS	NS	22 B
Arsenic	10	60	100	743
Barium	500	NS	3,000	726
Cadmium	4	20	20	7.9
Chromium	1	0.4	10	33.9
Copper	100	60	100	6,280
Iron	NS	NS	200	40,900
Lead	50	500	900	2,480
Mercury	0.3	0.1	30	4.5
Selenium	1	70	100	9.9
Silver	2	NS	50	5.1 B
Thallium	1	NS	NS	16.1
Vanadium	2	NS	20	52.3 B

Metals continued (mg/kg)				
Zinc	50	100	100	1,670

## Sector 2

- Four metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB02-03
Metals (mg/kg)				
Aluminum	7,800	NS	NS	13,600
Barium	550	210	NS	471
Chromium	23	4.2	NS	19
Mercury	NS	NS	1.3	2.4

- There were no exceedances of the Industrial RBC in Sector 2.
- Six metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB02-03
Metals (mg/kg)				
Aluminum	50	NS	600	13,600
Chromium	1	0.4	10	19
Iron	NS	NS	200	1,530
Lead	50	500	900	184
Mercury	0.3	0.1	30	2.4
Vanadium	2	NS	20	28.1 B

On the middle level (Sectors 3 and 4), a total of 20 inorganic constituents were detected above the limit of quantitation.

## Sector 3

- Fourteen metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB03-03
Metals (mg/kg)				
Aluminum	7,800	NS	NS	18,400
Antimony	3.1	1.3	NS	77.9
Arsenic	0.14	0.026	NS	6,850



Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB03-03
<b>Metals continued (mg/kg)</b>				
Barium	550	210	NS	1,000
Cadmium	3.9	2.7	NS	9.4
Chromium	23	4.2	NS	64.6
Copper	310	1,100	NS	388
Iron	2,300	NS	NS	74,600
Manganese	160	95	NS	100
Mercury	NS	NS	1.3	48.2
Selenium	39	1.9	NS	170
Silver	39	3.1	NS	6.5 B
Thallium	0.55	0.36	NS	9.1
Zinc	2,300	1,400	NS	1,510

- Antimony, detected at a concentration of 77.9 mg/kg, and arsenic, detected at a concentration of 6,850 mg/kg, both exceeded the Industrial RBC.
- Sixteen metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB03-03
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	18,400
Antimony	5	NS	NS	77.9
Arsenic	10	60	100	6,850
Barium	500	NS	3,000	1,000
Cadmium	4	20	20	9.4
Chromium	1	0.4	10	64.6
Cobalt	20	NS	1,000	54.1 B
Copper	100	60	100	388
Iron	NS	NS	200	74,600
Lead	50	500	900	5,410
Mercury	0.3	0.1	30	48.2
Selenium	1	70	100	170
Silver	2	NS	50	6.5 B
Thallium	1	NS	NS	9.1
Vanadium	2	NS	20	43.3 B
Zinc	50	100	100	1,510

## Sector 4

- Twelve metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM09-SB04-03
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	19,100
Antimony	3.1	1.3	NS	24.8 B
Arsenic	0.14	0.026	NS	176
Barium	550	210	NS	308
Cadmium	3.9	2.7	NS	5.5
Chromium	23	4.2	NS	48.9
Copper	310	1,100	NS	447
Iron	2,300	NS	NS	184,000
Mercury	NS	NS	1.3	3.6
Selenium	39	1.9	NS	271
Silver	39	3.1	NS	8.8 B
Thallium	0.55	0.36	NS	4

- Arsenic, detected at a concentration of 176 mg/kg, and iron, detected at a concentration of 184,000 mg/kg, both exceeded the Industrial RBC.
- Fourteen metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM09-SB04-03
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	19,100
Antimony	5	NS	NS	24.8 B
Arsenic	10	60	100	176
Cadmium	4	20	20	5.5
Chromium	1	0.4	10	48.9
Cobalt	20	NS	1,000	140
Copper	100	60	100	447
Iron	NS	NS	200	184,000
Lead	50	500	900	421
Mercury	0.3	0.1	30	2.3
Selenium	1	70	100	271
Thallium	1	NS	NS	4
Vanadium	2	NS	20	31.1 B
Zinc	50	100	100	1,030

Samples from the lower sample interval were not collected from the lower level due to native soil being encountered in depths less than 15-ft bgs.

#### **Summary of the 15-ft. to native interval**

- Arsenic was detected above the limit of quantitation in three of the four samples collected from this interval (SM09-SB01-03, SM09-SB03-03 and SM09-SB04-03) and exceeded all three soil screening criteria in each of these samples.
- Chromium was detected above the limit of quantitation in each of the four samples and exceeded both the Residential RBC and Ecological criteria in each of the samples from this interval.
- Mercury was detected above the limit of quantitation in all four samples from this interval and exceeded the Residential RBC and Ecological criteria in each sample.
- The purplish red, oxidized silt was encountered from 15-ft to 25-ft in borings collected from Sector 4, which may explain the elevated concentrations of arsenic and iron detected in this interval.

Soil analytical results from the 1 to 15 foot interval are presented in plan view on Figure 6b. All soil analytical detections are presented in Appendix E.

#### **4.3.2 SWMU 13**

Five test pits were excavated across the entire width of the unit and two test pits were excavated along the short axis of SWMU 13 and were identified as SM13-TP01 through SM13-TP07 (Figure 7). Samples were collected from the interval that exhibited the highest Photoionization Detector (PID) reading. The samples at SWMU 13 were collected from test pits SM13-TP05 and SM13-TP07.

##### **SM13-TP05-01**

- Nine VOCs, eight SVOCs, p,p'-DDD, p,p'-DDT, and eighteen metals were detected above the limit of quantitation.
- Three VOCs (chloroform, tetrachloroethylene (PCE) and trichloroethylene (TCE)), four SVOCs (2,4-Dinitrotoluene, 2,6-Dinitrotoluene, acetophenone and

nitrobenzene) four metals (aluminum, arsenic, chromium, and iron) exceeded the Residential RBC and/or the DAF 20 and Ingestion of VOCs.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM13-TP05-01
<b>VOCs (µg/kg)</b>				
Chloroform	78,000	0.9	370	930 E
Tetrachloroethylene (PCE)	32,000	24	14,000	64
Trichloroethylene (TCE)	1,600	0.3	6,100	13
<b>SVOCs (µg/kg)</b>				
2,4-Dinitrotoluene	16,000	57	NS	1,400
2,6-Dinitrotoluene	7,800	25	NS	380 J
Acetophenone	780,000	0.022	NS	24 J
Nitrobenzene	3,900	2.3	12,000	53 J
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	14,100
Arsenic	0.43	0.026	NS	5.3
Chromium	23	4.2	NS	29.8
Iron	2,300	NS	NS	25,900 J

- Arsenic was detected above the limit of quantitation at a concentration of 5.3 mg/kg and exceeded the Industrial RBC of 1.9 mg/kg.
- Four metals (aluminum, chromium, iron and vanadium) exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM13-TP05-01 (mg/kg)
Aluminum	50	NS	600	14,100
Chromium	1	0.4	10	29.8
Iron	NS	NS	200	25,900 J
Vanadium	2	NS	20	31.7 J

A duplicate sample, SM13-TP05-01A, was collected at SM13-TP05-01 and yielded similar results as SM13-TP05-01.

#### SM13-SB07-01

- PCE, toluene, 16 SVOCs, five pesticides and 15 metals were detected above the limit of quantitation.
- Two VOCs (PCE and toluene), six SVOCs, two pesticides (beta-BHC and gamma-BHC (Lindane)), and four metals (antimony, arsenic, barium, and chromium) exceeded the Residential RBC and/or the DAF 20 and Ingestion of VOCs.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM13-TP07-01
<b>VOCs (µg/kg)</b>				
Tetrachloroethylene (PCE)	32,000	24	14,000	450,000
Toluene	1,600,000	880	220,000	3,000 J
<b>SVOCs (µg/kg)</b>				
1,2,4-Trichlorobenzene	78,000	28	23,000	590 J
1,2-Dichlorobenzene	700,000	460	400,000	50,000
1,3-Dichlorobenzene	230,000	290	NS	590 J
1,4-Dichlorobenzene	27,000	7.1	1,400,000	11,000
2,4-Dinitrotoluene	16,000	57	NS	42,000
2,6-Dinitrotoluene	7,800	25	NS	13,000
<b>Pesticides (µg/kg)</b>				
beta-BHC	350	3.1	7,900	120 J
gamma-BHC (Lindane)	490	4.3	NS	190 J
<b>Metals (mg/kg)</b>				
Antimony	3.1	1.3	NS	1.6 B
Arsenic	0.43	0.026	NS	17.4
Barium	550	210	NS	213
Chromium	23	4.2	NS	101

- PCE, which was detected at a concentration of 450,000 µg/kg, exceeded the Industrial RBC of 140,000 µg/kg. Arsenic, which was detected at a concentration of 17.4 µg/kg exceeded the Industrial RBC of 1.9 mg/kg.
- Six metals exceeded the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM13-TP07-01
<b>Metals (mg/kg)</b>				
Arsenic	10	60	100	17.4
Chromium	1	0.4	10	101
Lead	50	500	900	259 J

Mercury	0.3	0.1	30	0.5 L
Vanadium	2	NS	20	26.9 J
Zinc	50	100	100	111 J

- PCBs were not detected above the limits of quantitation in samples collected at SWMU 13.

Figure 7 presents SWMU 13 analytical results in plan view. All soil analytical detections are presented in Appendix E.

### 4.3.3 SWMU 14

Six test pits were excavated along the perimeter and in the centerline of the unit and were identified as SM14-TP01 through SM14-TP06 (Figure 8). Test pits SM14-TP03 and SM14-TP06 were sampled in the method described in Section 3.4 based on the test pits exhibiting the greatest amount of cuprous chloride and cupric chloride waste and identified as SM14-TP03-01 and SM14-TP06-01.

#### SM14-TP03-01

- Five VOCs, 23 SVOCs, five pesticides, PCB-1260 (arochlor 1260) and 22 metals were detected above the limit of quantitation.
- Three VOCs (chloroform, PCE, and TCE), 11 SVOCs, five pesticides (alpha-BHC, beta-BHC, p,p'-DDD, p,p'-DDE, and p,p'-DDT) and 10 metals exceeded the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM14-TP03-01
<b>VOCs (µg/kg)</b>				
Chloroform	78,000	0.9	370	1.6 J
Tetrachloroethylene (PCE)	32,000	24	14,000	28
Trichloroethylene (TCE)	1,600	0.3	6,100	1.4 J
<b>SVOCs (µg/kg)</b>				
2,4-Dinitrotoluene	16,000	57	NS	5,400
2,6-Dinitrotoluene	7,800	25	NS	1,400
2-Nitroaniline	NS	NS	160	540 J
Benzo(a)anthracene	870	1,500	3,900	3,300

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM14-TP03-01
Benzo(a)pyrene	87	370	NS	2,900
Benzo(b)fluoranthene	870	4,500	NS	3,800
Chrysene	87,000	150,000	NS	4,200
Dibenzo(a,h)anthracene	87	1,400	NS	870 J
Hexachlorobenzene	400	52	1,300	340 J
Indeno(1,2,3-c,d)pyrene	870	13,000	NS	2,300
Nitrobenzene	3,900	2.3	12,000	300 J
<b>Pesticides (µg/kg)</b>				
alpha-BHC	100	0.89	990	2,300
beta-BHC	350	3.1	7,900	1,500
p,p'-DDD	2,700	11,000	NS	6,500
p,p'-DDE	1,900	35,000	NS	5,300
p,p'-DDT	1,900	1,200	990,000	28,000
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	8,990
Antimony	3.1	1.3	NS	12.4
Arsenic	0.43	0.026	NS	35.2
Barium	550	210	NS	599
Chromium	23	4.2	NS	65.3
Copper	310	1,100	NS	107,000
Iron	2,300	NS	NS	128,000
Manganese	160	95	NS	189
Selenium	39	1.9	NS	56.6
Silver	39	3.1	NS	15.9

- Benzo(a)pyrene and dibenzo(a,h)anthracene, alpha-BHC, p,p'-DDT and three metals (arsenic, copper, and iron) exceeded the Industrial RBC.

Analyte	Industrial RBC	SM14-TP03-01
<b>SVOCs (µg/kg)</b>		
Benzo(a)pyrene	390	2,900
Dibenzo(a,h)anthracene	390	870 J
<b>Pesticides (µg/kg)</b>		
alpha-BHC	450	2,300
p,p'-DDT	8,400	28,000
<b>Metals (mg/kg)</b>		
Arsenic	1.9	35.2
Copper	4,100	107,000

Iron	31,000	128,000
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- Fifteen metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM14-TP03-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	8,990
Antimony	5	NS	NS	12.4
Arsenic	10	60	100	35.2
Barium	500	NS	3,000	599
Chromium	1	0.4	10	65.3
Copper	100	60	100	107,000
Iron	NS	NS	200	128,000
Lead	50	500	900	2,000 J
Manganese	500	NS	100	189
Mercury	0.3	0.1	30	0.93 L
Nickel	30	200	90	90.6
Selenium	1	70	100	56.6
Silver	2	NS	50	15.9
Vanadium	2	NS	20	47.7
Zinc	50	100	100	209 J

#### SM14-TP06-01

- Four VOCs, 24 SVOCs, three pesticides, 18 metals, and cyanide were detected above the limit of quantitation.
- Two VOCs (PCE and TCE), 12 SVOCs, three pesticides (p,p'-DDD, p,p'-DDE, and p,p'-DDT), and six metals exceeded the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM14-TP06-01
<b>VOCs (µg/kg)</b>				
Tetrachloroethylene (PCE)	32,000	24	14,000	220
Trichloroethylene (TCE)	1,600	0.3	6,100	8.4
<b>SVOCs (µg/kg)</b>				
1,2,4-Trichlorobenzene	78,000	28	23,000	76 J
1,3-Dinitrobenzene	780	3.65	NS	300,000 D
2,4-Dinitrotoluene	16,000	57	NS	590 J



Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM14-TP06-01
2,6-Dinitrotoluene	7,800	25	NS	160 J
Azobenzene	5,800	35	83,000	43 J
Benzo(a)anthracene	870	1,500	3,900	900
Benzo(a)pyrene	87	370	NS	940
Benzo(b)fluoranthene	870	4,500	NS	1,800
Dibenzo(a,h)anthracene	87	1,400	NS	350 J
Hexachlorobenzene	400	52	1,300	16,000 DJ
Indeno(1,2,3-c,d)pyrene	870	13,000	NS	900
Nitrobenzene	3,900	2.3	12,000	230 J
<b>Pesticides (µg/kg)</b>				
p,p'-DDD	2,700	11,000	NS	6,800
p,p'-DDE	1,900	35,000	NS	2,900
p,p'-DDT	1,900	1,200	990,000	28,000
<b>Metals (mg/kg)</b>				
Antimony	3.1	1.3	NS	3.2 B
Arsenic	0.43	0.026	NS	29.6
Barium	550	210	NS	406
Chromium	23	4.2	NS	106
Copper	310	1,100	NS	32,700
Selenium	39	1.9	NS	8

- Three SVOCs (1,3-Dinitrobenzene, benzo(a)pyrene, and hexachlorobenzene), p,p'-DDT, arsenic and copper exceeded the Industrial RBC.

Analyte	Industrial RBC	SM14-TP06-01
<b>SVOCs (µg/kg)</b>		
1,3-Dinitrobenzene	10,000	300,000 D
Benzo(a)pyrene	390	940
Hexachlorobenzene	1,800	16,000 DJ
<b>Pesticides (µg/kg)</b>		
p,p'-DDT	8,400	28,000
<b>Metals (mg/kg)</b>		
Arsenic	1.9	29.6
Copper	4,100	32,700

- Eleven metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM14-TP06-01
<b>Metals (mg/kg)</b>				
Arsenic	10	60	100	29.6
Chromium	1	0.4	10	106
Copper	100	60	100	32,700
Lead	50	500	900	1,670 J
Mercury	0.3	0.1	30	0.79 J
Nickel	30	200	90	115
Selenium	1	70	100	8
Silver	2	NS	50	2.1
Tin	50	NS	2,000	230
Vanadium	2	NS	20	41.3
Zinc	50	100	100	256 J

- A duplicate sample, SM14-TP06-01A, was collected at SM14-TP06-01 and was only analyzed for copper, yielding similar results. Copper was detected at a concentration of 32,700 mg/kg and 34,500 mg/kg at SM14-TP06-01 and SM14-TP06-01A, respectively, and exceeded Residential RBC, Industrial RBC and Ecological criteria in both samples.
- Herbicides were not detected above the limits of quantitation in this sample.

Figure 8 presents SWMU 14 analytical results in plan view. All soil analytical detections are presented in Appendix E.

#### 4.3.4 SWMU 15

Eight test pits were excavated along the perimeter of SWMU 15 during the RFI and are identified as SM15-TP01 through SM15-TP08 (Figure 9). Three test pits were sampled following the method described in Section 3.4 and were identified as SM15-TP01-01, SM15-TP03-01 and SM15-TP07-01.

##### SM15-TP01-01

- Nine VOCs, 26 SVOCs, four pesticides, and PCB-1254 (arochlor 1254) were detected above the limit of quantitation.

- Seven VOCs, nine SVOCs, beta-BHC, p,p'-DDT and PCB-1254 (arochlor 1254) exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM15-TP01-01
<b>VOCs (µg/kg)</b>				
1,2,4-Trichlorobenzene	78,000	28	23,000	330 J
1,2-Dichlorobenzene	700,000	460	400,000	4,000
1,4-Dichlorobenzene	27,000	7.1	1,400,000	780
cis-1,2-Dichloroethylene	78,000	35	100,000	4,300
Tetrachloroethylene (PCE)	32,000	24	14,000	15,000
Trichloroethylene (TCE)	1,600	0.3	6,100	6,700
Vinyl Chloride	90	0.3	370	120 J
<b>SVOCs (µg/kg)</b>				
2,4-Dinitrotoluene	16,000	57	NS	210 J
2,6-Dinitrotoluene	7,800	25	NS	57 J
Acetophenone	780,000	0.022	NS	25 J
Benzo(a)pyrene	87	370	NS	770
Chrysene	87,000	150,000	NS	780
Dibenzo(a,h)anthracene	87	1,400	NS	170 J
Hexachlorobenzene	400	52	1,300	330 J
Naphthalene	160,000	15	23,000	28 J
Nitrobenzene	3,900	2.3	51,000	18 J
<b>Pesticides (µg/kg)</b>				
beta-BHC	350	3.1	7,900	480 J
p,p'-DDT	1,900	1,200	990,000	3,000 J
<b>PCBs (µg/kg)</b>				
PCB-1254 (Arochlor 1254)	156	1,100	2,900	280 J

- Benzo(a)pyrene was detected at a concentration of 770 µg/kg and exceeded the Industrial RBC of 390 µg/kg.
- There were no exceedances of the Ecological criteria in SM15-TP01-01.

### SM15-TP03-01

- Five VOCs and 23 metals were detected above limit of quantitation.
- Two VOCs (chloroform and TCE) and nine metals exceeded at least one component of the Residential RBC criteria.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM15-TP03-01
<b>VOCs (µg/kg)</b>				
Chloroform	78,000	0.9	370	1.8 B
Trichloroethylene (TCE)	1,600	0.3	6,100	4.6 J
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	8,700
Antimony	3.1	1.3	NS	4 B
Arsenic	0.43	0.026	NS	17
Barium	550	210	NS	213
Chromium	23	4.2	NS	184
Copper	310	1,100	NS	1,500
Iron	2,300	NS	NS	25,100 J
Manganese	160	95	NS	1,040 J
Selenium	39	1.9	NS	2.5

- Arsenic was detected at a concentration of 17 mg/kg and exceeded the Industrial RBC of 1.9 mg/kg.
- Eleven metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM15-TP03-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	8,700
Arsenic	10	60	100	17
Chromium	1	0.4	10	184
Copper	100	60	100	1,500
Iron	NS	NS	200	25,100 J
Lead	50	500	900	141 J
Manganese	500	NS	100	1,040 J
Mercury	0.3	0.1	30	1.2 L
Selenium	1	70	100	2.5
Vanadium	2	NS	20	34.2 J
Zinc	50	100	100	148 J

## SM15-TP07-01

- Nine VOCs, 14 SVOCs, and 22 metals were detected above the limit of quantitation.
- Chloroform, TCE, four SVOCs (1,2,4-Trichlorobenzene, 1,4-Dichlorobenzene, benzo(a)pyrene and hexachlorobenzene), and six metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	Ingestion VOCs	SM15-TP07-01
<b>VOCs (µg/kg)</b>				
Chloroform	78,000	0.9	370	2.7 B
Trichloroethylene (TCE)	1,600	0.3	6,100	3.8 J
<b>SVOCs (µg/kg)</b>				
1,2,4-Trichlorobenzene	78,000	28	23,000	310 J
1,4-Dichlorobenzene	27,000	7.1	1,400,000	230 J
Benzo(a)pyrene	87	370	NS	210 J
Hexachlorobenzene	400	52	1,300	1,800 J
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	9,310
Antimony	3.1	1.3	NS	1.5 B
Arsenic	0.43	0.026	NS	18.4
Chromium	23	4.2	NS	30.2
Iron	2,300	NS	NS	32,200 J
Manganese	160	95	NS	180 J

- Arsenic was detected at a concentration of 18.4 mg/kg and exceeded the Industrial RBC of 1.9 mg/kg. Iron was detected at a concentration of 32,200 and exceeded the Industrial RBC of 31,000 mg/kg.
- Eleven metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM15-TP07-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	9,310
Arsenic	10	60	100	18.4
Chromium	1	0.4	10	30.2
Copper	100	60	100	84

Analyte	Phytotoxicity	Soil & Litter Invertebrates	Microorganism/ Microbes	SM15-TP07-01
Iron	NS	NS	200	32,200 J
Lead	50	500	900	132 J
Manganese	500	NS	100	180 J
Mercury	0.3	0.1	30	0.76 L
Selenium	1	70	100	1.3
Vanadium	2	NS	20	31.5 J
Zinc	50	100	100	161 J

Figure 9 presents SWMU 15 analytical results in plan view. All soil analytical detections are presented in Appendix E.

#### 4.3.5 SWMU 17

A Geoprobe<sup>TM</sup> was used to advance 17 borings on the pad that overlies SWMU 17 (Figure 10). The borings were advanced to depths between 4 and 12-ft and were identified as SM17-GP01 through SM17-GP17. One soil sample was collected from SM17-GP01 in the interval exhibiting the highest PID reading and was identified as SM17-GP01-01.

#### SM17-GP01-01

- Ten VOCs, six SVOCs, three pesticides, 17 metals, and cyanide were detected above the limits of quantitation.
- Nine VOCs, four SVOCs, three pesticides and eight metals exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	VOC Ingestion	SM17-GP01-01
<b>VOCs (µg/kg)</b>				
Benzene	12,000	1.9	1,100	60,000 J
Carbon Tetrachloride	4,900	2.1	430	42,000 J
Chlorobenzene	160,000	80	17,000	240,000
Chloroform	78,000	0.9	370	63,000 J
Ethylbenzene	780,000	1,500	730,000	1,100,000
o-Xylene	1,600,000	300	NS	380,000
p,m-Xylene	1,600,000	300	NS	2,200,000

Analyte	Residential RBC	DAF 20	VOC Ingestion	SM17-GP01-01
Tetrachloroethylene (PCE)	32,000	24	14,000	2,100,000
Trichloroethylene (TCE)	1,600	0.3	6,100	470,000
<b>SVOCs (µg/kg)</b>				
1,2-Dichlorobenzene	700,000	460	400,000	500,000
1,4-Dichlorobenzene	27,000	7.1	1,400,000	5,200 J
Phenol	2,300,000	6,700	NS	12,000 J
Pyridine	7,800	NS	NS	10,000 J
<b>Pesticides (µg/kg)</b>				
alpha-BHC	100	0.89	990	84,000 J
p,p'-DDD	2,700	11,000	NS	580,000 J
p,p'-DDT	1,900	1,200	990,000	1,400,000 J
<b>Metals (mg/kg)</b>				
Antimony	3.1	1.3	NS	230
Arsenic	0.43	0.026	NS	510
Barium	550	210	NS	347
Cadmium	3.9	2.7	NS	5.8
Chromium	23	4.2	NS	83.7
Lead	NS	NS	NS	428 J
Mercury	NS	NS	1.3	19.9 L
Selenium	39	1.9	NS	20.3

- Four VOCs (benzene, carbon tetrachloride, PCE, and TCE), alpha-BHC, p,p'-DDD, p,p'-DDT, antimony, and arsenic exceeded the Industrial RBC.

Analyte	Industrial RBC	SM17-GP01-01
<b>VOCs (µg/kg)</b>		
Benzene	52,000	60,000 J
Carbon Tetrachloride	22,000	42,000 J
Tetrachloroethylene (PCE)	140,000	2,100,000
Trichloroethylene (TCE)	7,200	470,000
<b>Pesticides (µg/kg)</b>		
alpha-BHC	450	84,000 J
p,p'-DDD	12,000	580,000 J
p,p'-DDT	8,400	1,400,000 J
<b>Metals (mg/kg)</b>		
Antimony	41	230
Arsenic	1.9	510

- Nine metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil and Litter Invertebrates	Microorganism/ Microbes	SM17-GP01-01
<b>Metals (mg/kg)</b>				
Antimony	5	NS	NS	230
Arsenic	10	60	100	510
Cadmium	4	20	20	5.8
Chromium	1	0.4	10	83.7
Lead	50	500	900	428 J
Mercury	0.3	0.1	30	19.9 L
Selenium	1	70	100	20.3
Tin	50	NS	2000	2810
Vanadium	2	NS	20	14.9 J

Figure 10 presents SWMU 17 analytical results in plan view. All soil analytical detections are presented in Appendix E.

#### 4.3.6 SWMU 18

Twelve test pits, identified as SM18-TP01 through SM18-TP12, were excavated along the perimeter and outside of the geophysical boundary (Figure 11). Two soil samples were collected in the vicinity of buried bottles that were located in Test Pits 8 and 9 and were identified as SM18-TP08-01 and SM18-TP09-01.

##### SM18-TP08-01

- Twelve VOCs, 24 SVOCs, three pesticides, and 22 metals were detected above the limit of quantitation.
- Ten VOCs, three SVOCs, three pesticides, and eight metals exceeded at least one component of the Residential criteria.



Analyte	Residential RBC	DAF 20	VOC Ingestion	SM18-TP08-01
<b>VOCs (µg/kg)</b>				
1,1,2,2-Tetrachloroethane	3,200	0.7	740	1,600
1,1,2-Trichloroethane	11,000	0.8	1,300	280 J
1,2-Dichlorobenzene	700,000	460	400,000	2,500
1,2-Dichloroethane	7,000	1	470	460 J
1,4-Dichlorobenzene	27,000	7.1	1,400,000	3,000
Carbon Tetrachloride	4,900	2.1	430	13,000
Chlorobenzene	160,000	80	17,000	7,500
Chloroform	78,000	0.9	370	8,200
Cis-1,2-Dichloroethylene	78,000	35	NS	200 J
Tetrachloroethylene (PCE)	32,000	24	14,000	730 J
<b>SVOCs (µg/kg)</b>				
Benzo(a)pyrene	87	370	NS	240 J
Fluorene	310,000	14,000	NS	19 J
Naphthalene	160,000	15	23,000	57 J
<b>Pesticides (µg/kg)</b>				
p,p'-DDD	2,700	11,000	NS	18,000 J
p,p'-DDE	1,900	35,000	NS	6,700 J
p,p'-DDT	1,900	1,200	990,000	6,900 J
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	16,700
Antimony	3.1	1.3	NS	1.9 B
Arsenic	0.43	0.026	NS	30.9
Barium	550	210	NS	323
Chromium	23	4.2	NS	24.9
Iron	2,300	NS	31,000	27,900 J
Manganese	160	95	NS	828 J
Selenium	39	1.9	NS	1.5

- The pesticide, p,p'-DDD was detected at a concentration of 18,000 µg/kg and exceeded the Industrial RBC of 12,000 µg/kg. Arsenic was detected at a concentration of 30.9 mg/kg and exceeded the Industrial RBC of 1.9 mg/kg.

- Eleven metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil and Litter Invertebrates	Microorganism/ Microbes	SM18-TP08-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	16,700
Arsenic	10	60	100	30.9
Chromium	1	0.4	10	24.9
Copper	100	60	100	109
Iron	NS	NS	200	27,900 J
Lead	50	500	900	198 J
Manganese	500	NS	100	828 J
Mercury	0.3	0.1	30	0.43 L
Selenium	1	70	100	1.5
Vanadium	2	NS	20	35.7
Zinc	50	100	100	129 J

#### SM18-TP09-01

- Eleven VOCs, 18 SVOCs, three pesticides, and 19 metals were detected above the limit of quantitation.
- Three VOCs (1,2-Dichloroethane, 1,4-Dioxane, and chloroform), benzo(a)pyrene, beta-BHC, p,p'-DDT, and five metals (aluminum, arsenic, chromium, iron, and manganese) exceeded the Residential RBC.

Analyte	Residential RBC	DAF 20	VOC Ingestion	SM18-TP09-01
<b>VOCs (µg/kg)</b>				
1,2-Dichloroethane	7,000	1	470	20
1,4-Dioxane (p-dioxane)	58,000	26.3	NS	2,300 L
Chloroform	78,000	0.9	370	14 B
<b>SVOCs (µg/kg)</b>				
Benzo(a)pyrene	87	370	NS	220 J
<b>Pesticides (µg/kg)</b>				
beta-BHC	350	3.1	7,900	110 J
p,p'-DDT	1,900	1,200	990,000	2,000 J

Analyte	Residential RBC	DAF 20	VOC Ingestion	SM18-TP09-01
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	11,000
Arsenic	0.43	0.026	NS	11.4
Chromium	23	4.2	NS	26.3
Iron	2,300	NS	NS	23,400 J
Manganese	160	95	NS	200 J

- Arsenic was detected at a concentration of 30.9 mg/kg and was the only analyte that exceeded the Industrial RBC of 1.9 mg/kg.
- Five metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil and Litter Invertebrates	Microorganism/ Microbes	SM18-TP09-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	11,000
Arsenic	10	60	100	11.4
Chromium	1	0.4	10	26.3
Iron	NS	NS	200	23,400 J
Manganese	500	NS	100	200 J

- Neither herbicides nor PCBs were detected above the limit of quantitation in SWMU 18.

Figure 11 presents SWMU 18 analytical results in plan view. All soil analytical detections are presented in Appendix E.

#### 4.3.7 SWMU 19

Five test pits were excavated along the perimeter of the geophysical boundary and were identified as SM19-TP01 through SM19-TP05 (Figure 12). Two soil samples were collected in the same method defined in Section 3.4 and were identified as SM19-TP03-01 and SM19-TP04-01.

### SM19-TP03-01

- Chlorobenzene, 17 SVOCs, three pesticides, 16 metals, and sulfide were detected above the limit of quantitation.
- Chlorobenzene, 1,4-Dichlorobenzene, naphthalene, arsenic, and chromium exceeded at least one component of the Residential RBC.

Analyte	Residential RBC	DAF 20	VOC Ingestion	SM19-TP03-01
<b>VOCs (µg/kg)</b>				
Chlorobenzene	160,000	80	17,000	23,000
<b>SVOCs (µg/kg)</b>				
1,4-Dichlorobenzene	27,000	7.1	1,400,000	18 J
Naphthalene	160,000	15	23,000	42 J
<b>Metals (mg/kg)</b>				
Arsenic	0.43	0.026	NS	8.5
Chromium	23	4.2	NS	17 K

- Arsenic was detected at a concentration of 8.5 mg/kg and exceeded the Industrial RBC of 1.9 mg/kg.
- Three metals exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil and Litter Invertebrates	Microorganism/ Microbes	SM19-TP03-01
<b>Metals (mg/kg)</b>				
Chromium	1	0.4	10	17 K
Selenium	1	70	100	1.1
Vanadium	2	NS	20	26.3

- Herbicides and PCBs were not detected above the limit of quantitation.

### SM19-TP04-01

- Chloroform and three pesticides (p,p'-DDD, p,p'-DDE and p,p'-DDT) were detected above the limit of quantitation; all three exceeded the Residential RBC.

Analyte	Residential RBC	DAF 20	VOC Ingestion	SM19-TP04-01
<b>VOCs (µg/kg)</b>				
Chlorobenzene	160,000	80	17,000	260,000
<b>Pesticides (µg/kg)</b>				
p,p'-DDD	2,700	11,000	NS	35,000
p,p'-DDE	1,900	35,000	NS	51,000
p,p'-DDT	1,900	1,200	990,000	49,000

- p,p'-DDD, p,p'-DDE, and p,p'-DDT exceeded the Industrial RBC.

Analyte	Industrial RBC	SM19-TP04-01
<b>Pesticides (µg/kg)</b>		
p,p'-DDD	12,000	35,000
p,p'-DDE	8,400	51,000
p,p'-DDT	8,400	49,000

- Chloroform, which was detected at a concentration of 260,000 µg/kg, exceeded the Ecological criteria of 40,000 µg/kg for Soil and Litter Invertebrates.
- Herbicides and PCBs were not detected above the limit of quantitation at either SM19-TP03-01 or SM19-TP04-01.

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Figure 12 presents SWMU 19 analytical results in plan view. All soil analytical detections are presented in Appendix E.

#### 4.3.8 SWMU 20

Five test pits were excavated along the perimeter of the geophysical boundary and were identified as SM20-TP01 through SM20-TP05 (Figure 13). Two soil samples were collected in the same method described in Section 3.4 and were identified as SM20-TP02-01 and SM20-TP03-01.

### SM20-TP02-01

- Acetone, methylene chloride, bis(2-Ethylhexyl)phthalate, 20 metals, fluoride, and sulfide were detected above the limit of quantitation.
- Five metals (aluminum, arsenic, chromium, iron, and manganese) exceeded at least one component of the Residential RBC criteria.

Analyte	Residential RBC	DAF 20	VOC Ingestion	SM20-TP02-01
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	12,200
Arsenic	0.43	0.026	NS	5.1
Chromium	23	4.2	NS	22 K
Iron	2,300	NS	NS	20,400
Manganese	160	95	NS	96.5

- Arsenic was detected at a concentration of 5.1 mg/kg and exceeded the Industrial RBC of 1.9 mg/kg.
- Four metals (aluminum, chromium, iron, and vanadium) exceeded at least one of the components of the Ecological criteria.

Analyte	Phytotoxicity	Soil and Litter Invertebrates	Microorganism/ Microbes	SM20-TP02-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	12,200
Chromium	1	0.4	10	22 K
Iron	NS	NS	200	20,400
Vanadium	2	NS	20	40.7

- Pesticides, Herbicides, and PCBs were not detected above the limit of quantitation.

### SM20-TP03-01

- Twenty metals and fluoride were detected above the limit of quantitation.
- Five metals (aluminum, arsenic, chromium, iron, and manganese) exceeded at least one component of the Residential RBC criteria.

Analyte	Residential RBC	DAF 20	VOC Ingestion	SM20-TP03-01
<b>Metals (mg/kg)</b>				
Aluminum	7,800	NS	NS	15,700
Arsenic	0.43	0.026	NS	4.3
Chromium	23	4.2	NS	25.8 K
Iron	2,300	NS	NS	19,300
Manganese	160	95	NS	138

- Arsenic was detected at a concentration of 4.3 mg/kg and exceeded the Industrial RBC of 1.9 mg/kg.
- Six metals (aluminum, chromium, iron, manganese, selenium, and vanadium) exceeded at least one component of the Ecological criteria.

Analyte	Phytotoxicity	Soil and Litter Invertebrates	Microorganism/ Microbes	SM20-TP03-01
<b>Metals (mg/kg)</b>				
Aluminum	50	NS	600	15,700
Chromium	1	0.4	10	25.8 K
Iron	NS	NS	200	19,300
Manganese	500	NS	100	138
Selenium	1	70	100	1.1
Vanadium	2	NS	20	34.7

- Pesticides, Herbicides, and PCBs were not detected above the limit of quantitation.

Figure 13 presents SWMU 20 analytical results in plan view. All soil analytical detections are presented in Appendix E.

## **5.0 SITE INVESTIGATION ANALYTICAL RESULTS FOR GROUNDWATER**

The following section presents the analytical results of the groundwater sampling conducted as part of the RFI. The results are presented on a sitewide basis to develop an overview of groundwater quality and on a SWMU specific basis to focus on individual SWMU groundwater quality.

### **5.1 SUMMARY OF ANALYTICAL SAMPLE RESULTS FOR GROUNDWATER QUALITY ASSESSMENT**

Twenty-four groundwater samples and nine QA/QC samples were collected from test pits, Geoprobe™ groundwater sampling, and monitoring well sampling during the RFI. Tables 2 and 3 provide summaries of samples collected and analytical tests completed for each sampling point. Complete groundwater analytical detections and exceedances are presented in Appendix F, and results were compared to Tap Water RBC (Referred in Appendix F as Groundwater RBC) and Maximum Contaminant Levels (MCL).

#### **5.1.1 Summary of Sitewide Groundwater Analytical Results for VOCs**

Thirty-three individual VOCs were detected above the limit of quantitation in the groundwater samples collected during the RFI. Twenty-seven constituents exceeded the groundwater RBC in at least one sample and 12 constituents exceeded the MCL in at least one sample. Table 6 presents a complete list of all VOCs detected within sitewide groundwater, their minimum and maximum detections, and average detection levels.

Acetone, chloroform, cis 1,2-Dichloroethylene (cis 1,2-DCE), total 1,2-Dichloroethylene, tetrachloroethylene (PCE), and trichloroethylene (TCE) were the most commonly detected volatile organic constituents. The following section presents a synopsis of the detections and exceedances of regulatory criteria for sitewide groundwater samples collected during the RFI:

- Acetone and chloroform were each detected above the limit of quantitation in 10 samples in concentrations ranging from 1.6 micrograms per Liter (µg/L) to 14,000 µg/L, and from 3.1 µg/L to 41,000 µg/L, respectively. Acetone exceeded the Tap



Water RBC in six samples and chloroform exceeded the Tap Water RBC in 10 samples. Neither compound exceeded the MCL.

- Cis 1,2-DCE was detected above the limit of quantitation in 12 groundwater samples at concentrations ranging from 1.2 µg/L to 110,000 µg/L. Ten of the 12 detections exceeded the Tap Water RBC and six of the 12 detections exceeded the MCL.
- Total 1,2-dichloroethylene was detected above the limit of quantitation in 12 samples at concentrations ranging from 1.3 µg/L to 110,000 µg/L. Neither the Tap Water RBC nor the MCL were exceeded.
- TCE was detected above the limit of quantitation in 14 groundwater samples at concentrations ranging from 1.3 µg/L to 48,000 µg/L. The Tap Water RBC was exceeded in each of the 14 samples and the MCL was exceeded in 12 of the 14 samples.
- PCE was detected above the limit of quantitation in nine samples at concentrations ranging from 1.5 µg/L to 23,000 µg/L. The Tap Water RBC was exceeded in each sample and the MCL was exceeded in eight of the nine samples.

### **5.1.2 Summary of Sitewide Groundwater Analytical Results for SVOCs**

Thirty individual SVOCs were detected above the limit of quantitation in the groundwater samples collected during the RFI. Sixteen of the 30 detected SVOCs exceeded the Tap Water RBC in at least one sample; however, only 1,2-Dichlorobenzene and 1,4-Dichlorobenzene exceeded the MCL. Table 6 provides a complete list of all SVOCs detected sitewide, their minimum and maximum detections, and average detection levels. Groundwater Analytical data are provided in Appendix F.

The semivolatile organic compounds aniline, 1,2-Dichlorobenzene, and phenol were the most commonly detected SVOCs. The frequency of detection, exceedances of regulatory standards, and the range of detections are presented below:

- 1,2-Dichlorobenzene was detected above the limit of quantitation in nine samples at concentrations ranging from 4.5 µg/L to 29,000 µg/L. The Tap Water RBC was exceeded in five of the nine samples and the MCL was exceeded in four of the nine samples.

- Aniline was detected above the limit of quantitation in seven samples at concentrations ranging from 0.63 µg/L to 800 µg/L. The Tap Water RBC was exceeded in one groundwater sample.
- Phenol was detected above the limit of quantitation in nine samples at concentrations ranging from 17 µg/L to 26,000 µg/L. The Tap Water RBC was exceeded in three samples; however, neither constituent exceeded the MCL.
- 1,4-Dichlorobenzene was detected above the limit of quantitation in five samples at concentrations ranging from 140 µg/L to 600 µg/L. The Tap Water RBC and MCL were exceeded in three of the five samples.

### 5.1.3 Summary of Sitewide Groundwater Analytical Results for Pesticides

Fourteen individual pesticides were detected above the limit of quantitation in the groundwater samples collected during the RFI. Ten of the 14 detected pesticides exceeded the Tap Water RBC in at least one sample; however, only one detected pesticide, gamma-BHC (Lindane), exceeded the MCL. Table 6 presents a complete list of all pesticides detected sitewide, their minimum and maximum detections, and average detection levels.

Alpha-BHC, beta-BHC and p,p'-DDD were the most commonly detected pesticides in groundwater samples collected during the RFI. The frequency of detection, exceedances of regulatory standards, and range of detections are presented below:

- Alpha-BHC was detected above the limit of quantitation in 14 samples at concentrations ranging from 0.075 µg/L to 850 µg/L. Alpha-BHC exceeded the Tap Water RBC in each of the 14 samples in which it was detected.
- Beta-BHC was detected above the limit of quantitation in 14 samples at concentrations ranging from 0.059 µg/L to 9.8 µg/L. Beta-BHC exceeded the Tap Water RBC in 11 of the 13 samples in which it were detected.
- p,p'-DDD was detected above the limit of quantitation in nine samples at concentrations ranging from 0.14 µg/L to 2,400 µg/L. The Tap Water RBC was exceeded in four of the nine samples in which it was detected.
- p,p'-DDT was detected above the limit of quantitation in seven samples at concentrations ranging from 0.16 µg/L to 8,500 µg/L. The Tap Water RBC was exceeded in five of the seven detections.

*Note: MCL criteria have not been established for alpha-BHC, beta-BHC, p,p'-DDD or p,p'-DDT.*

#### **5.1.4 Summary of Sitewide Groundwater Analytical Results for Total Metals**

Twenty-five individual total metal constituents were detected above the limit of quantitation in the groundwater samples collected during the RFI. Sixteen of 25 total metals detected exceeded the Tap Water RBC, and 10 inorganics exceeded the MCL. A small diameter peristaltic pump was used to collect groundwater samples at SWMUs 13 through 20 since these sample were collected for screening purposes; therefore it is likely that sediment and colloidal solids were suspended in samples resulting in elevated total metal concentrations. Table 6 presents a complete list of all total metals detected within sitewide groundwater, their minimum and maximum detections, and average detection levels.

Total barium and total zinc were the most commonly detected total metals, with total arsenic, total chromium, and total lead being the most common inorganic exceedances.

- Total barium and total zinc were detected above the limit of quantitation in 26 and 27 samples respectively. Detection concentrations ranged from 17.4 µg/L to 926 µg/L for total barium and from 4.7 µg/L to 7,790 µg/L for total zinc. The Tap Water RBC was exceeded in three samples for both total barium and total zinc; however, their respective MCL were not exceeded.
- Total arsenic was detected above the limit of quantitation in 15 samples at concentrations ranging from 4.9 µg/L to 101,000 µg/L. The Tap Water RBC was exceeded in 14 of the 15 samples. The MCL was exceeded for total arsenic in eight of the 15 samples.
- Total chromium was detected above the limit of quantitation in 25 samples at concentrations ranging from 1.4 µg/L to 291 µg/L. The Tap Water RBC was exceeded in 12 samples; however, the MCL was only exceeded in two samples.
- Total lead was detected above the limit of quantitation in 21 samples at concentrations ranging from 1.8 µg/L to 3,100 µg/L. The Tap Water RBC was exceeded in 13 samples and the MCL was exceeded in eight of the 21 samples.

### 5.1.5 Summary of Sitewide Groundwater Analytical Results for Dissolved Metals

Twenty-three individual dissolved metal constituents were detected above the limit of quantitation in the groundwater samples collected during the RFI. Thirteen of the 23 detected dissolved metals exceeded the Tap Water RBC; however, only six dissolved metal detections exceeded their MCL. Table 6 presents a complete list of all dissolved metals detected in sitewide groundwater, their minimum and maximum detections, and average detection levels.

Dissolved barium, boron, calcium, magnesium, manganese, potassium, sodium and zinc were the most commonly detected dissolved metals in samples collected during the RFI. Dissolved arsenic and antimony were the most common exceedances in dissolved metals detected in samples collected during the RFI.

- Dissolved barium was detected above the limit of quantitation in 21 samples at concentrations ranging from 15.3 µg/L to 196 µg/L. Dissolved boron was detected above the limit of quantitation in 20 samples at concentrations ranging from 85.1 µg/L to 41,300 µg/L. Dissolved calcium was detected above the limit of quantitation in 20 samples at concentrations ranging from 35,400 µg/L to 522,000 µg/L. Dissolved magnesium was detected above the limit of quantitation in 20 samples at concentrations ranging from 13,000 µg/L to 1,010,000 µg/L. Dissolved potassium was detected above the limit of quantitation in 20 samples at concentrations ranging from 800 µg/L to 70,000 µg/L. Dissolved sodium was detected above the limit of quantitation in 20 samples at concentrations ranging from 7,760 µg/L to 728,000 µg/L. Dissolved barium, boron, calcium, magnesium, potassium, and sodium did not exceed their corresponding Tap Water RBC or MCL in any of the samples in which they were detected.
- Dissolved zinc was detected above the limit of quantitation in 20 samples at concentrations ranging from 3.7 µg/L to 3,640 µg/L. Dissolved zinc exceeded the Tap Water RBC at one sample; however, the MCL was not exceeded in any sample.
- Dissolved manganese was detected above the limit of quantitation in 20 samples at concentrations ranging from 141 µg/L to 11,400 µg/L. The Tap Water RBC was exceeded in every sample; however, the MCL was not exceeded in any of the samples.
- Dissolved arsenic was detected above the limit of quantitation in 12 of the 24 samples during the RFI with a minimum detection of 6.2 µg/L and a maximum

detection of 95,900 µg/L. Dissolved arsenic exceeded the Tap Water RBC in each sample where it was detected and exceeded the MCL in 10 of the 12 samples.

- Dissolved antimony was detected above the limit of quantitation in seven samples at concentrations ranging from 4.8 µg/L to 2,400 µg/L. The Tap Water RBC was exceeded in seven samples; the MCL was exceeded in five of the seven samples.
- Dissolved lead was detected above the limit of quantitation in 10 samples at concentrations ranging from 1.7 µg/L to 241 µg/L. The Tap Water RBC was exceeded in four samples; the MCL was exceeded in two of the 10 samples.

### **5.1.6 Summary of Sitewide Groundwater Analytical Results for General Chemistry**

Two different general chemistry constituents, cyanide and fluoride, were detected above the limit of quantitation in the groundwater samples collected during the RFI. Cyanide was detected at a concentration of 77.6 µg/L in SM17-GP01-01 and exceeded the Tap Water RBC; however, the MCL was not exceeded. Although present in groundwater above the limit of quantitation, fluoride did not exceed either the Tap Water RBC or MCL.

## **5.2 SUMMARY OF GROUNDWATER ANALYTICAL RESULTS BY SWMU**

The following section presents the analytical results as they pertain to each of the 8 SWMUs and four monitoring well locations identified in the RFI Work Plan.

### **5.2.1 SWMU 9**

Three groundwater samples were collected within the unit; two from the lower level, closest to the Delaware River and the third was collected upgradient of the impoundment near the southwest edge of the unit (Figure 14). The samples are identified as SM09-GW01 through SM09-GW03, and were collected from the soil boring using a small diameter, disposable, plastic bailer.

**SM09-GW01** - Twenty-three total metals and 18 dissolved metals were detected above the limit of quantitation at SM09-GW01. Fourteen total metals and four dissolved metals exceeded the Tap Water RBC; however, only four total metals and dissolved arsenic exceeded the MCL at this sample location.

*by user*

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>Total Metals</b>			
Aluminum	3,700	NS	37,400
Antimony	1.5	6	15.7 B
Arsenic	0.045	10	174
Barium	260	2,000	926
Cadmium	1.8	5	7.9
Chromium	11	100	54.8
Copper	150	1,300	156
Iron	1,100	NS	67,700
Lead	5	15	665
Manganese	73	NS	3,110
Nickel	73	NS	171
Selenium	18	50	31.1
Vanadium	26	NS	49.2 B
Zinc	1,100	NS	7,790
<b>Dissolved Metals</b>			
Antimony	1.5	6	5.8 B
Arsenic	0.045	10	22.5
Manganese	73	NS	2,230
Selenium	18	50	22.4

**SM09-GW02** - Twenty-two total and dissolved metals were detected above the limit of quantitation at SM09-GW02. Twelve total metals and eight dissolved metals exceeded the Tap Water RBC and five total metals and three dissolved metals exceeded the MCL at this sample.

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Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>Total Metals</b>			
Aluminum	3,700	NS	77,900
Antimony	1.5	6	5.9 B
Arsenic	0.045	10	577
Beryllium	7.3	4	10.8
Cadmium	1.8	5	2.4 B
Chromium	11	100	138
Iron	1,100	NS	343,000

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
Lead	5	15	267
Manganese	73	NS	3,240
Thallium	0.26	2	4.3 B
Vanadium	26	NS	105
Zinc	1,100	NS	1,180
<b>Dissolved Metals</b>			
Aluminum	3,700	NS	50,500
Antimony	1.5	6	22 B
Arsenic	0.045	10	93
Beryllium	7.3	4	6.6
Cadmium	1.8	5	2 B
Iron	1,100	NS	1,130,000
Lead	5	15	13.8
Manganese	73	NS	11,400
Vanadium	26	NS	36.1 B

**SM09-GW03** - Twenty-three total metals and 22 dissolved metals were detected above the limit of quantitation at SM09-GW03. Fourteen total metals and 11 dissolved metals exceeded the Tap Water RBC; eight total metals and three dissolved metals exceeded the MCL. Total and dissolved arsenic was detected at 101,000 µg/L and 95,900 µg/L respectively; both the total and dissolved metals exceeded the Tap Water RBC and MCL at this location.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>Total Metals</b>			
Aluminum	3,700	NS	248,000
Antimony	1.5	6	178
Arsenic	0.045	10	101,000
Barium	260	2,000	525
Beryllium	7.3	4	10.4
Cadmium	1.8	5	80
Chromium	11	100	291
Cobalt	73	NS	173
Iron	1,100	NS	962,000
Lead	5	15	3,100

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
Manganese	73	NS	7,010
Mercury	NS	2	3
Nickel	73	NS	232
Thallium	0.26	2	95.5
Vanadium	26	NS	494
Zinc	1,100	NS	3,540
<b>Dissolved Metals</b>			
Aluminum	3,700	NS	187,000
Antimony	1.5	6	50.4 B
Arsenic	0.045	10	95,900
Cadmium	1.8	5	3.8 B
Chromium	11	100	27.1
Cobalt	73	NS	243
Iron	1,100	NS	1,360,000
Lead	NS	15	241
Manganese	73	NS	11,400
Nickel	73	NS	300
Vanadium	26	NS	53.6
Zinc	1,100	NS	3,640

Groundwater analytical results for SWMU 9 are presented in plan view on Figure 14 and the individual constituents exceeding the Tap Water RBC and/or MCL and highlighted in bold. All groundwater analytical results are presented in Appendix F.

### 5.2.2 SWMU 13

Two groundwater samples were collected via Geoprobe™ from near Test Pits 5 and 7 and were identified as SM13-GP01-01 and SM13-GP02-01 (Figure 15).

**SM13-GP01-01** - Eight VOCs, five SVOCs, five pesticides, 20 total metals, and 16 dissolved metals were detected above the limits of quantitation in this sample. Seven VOCs, four SVOCs, three pesticides, seven total metals and four dissolved metals exceeded the Tap Water RBC. Three VOCs, two SVOCs, and total and dissolved arsenic exceeded the MCL at this location.



Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
Acetone	61	NS	1,200 L
Benzene	0.34	5	2,600
Chloroform	0.15	NS	33,000 J
Ethylbenzene	130	700	540 J
Methylene Chloride	4.1	5	6,100
p,m-Xylene	21	NS	190 J
Tetrachloroethylene (PCE)	0.53	5	7,000 J
<b>SVOCs</b>			
1,2-Dichlorobenzene	27	600	720 J
1,4-Dichlorobenzene	0.47	75	140 J
Aniline	12	NS	140 J
o-Toluidine	0.28	NS	1,900
<b>Pesticides</b>			
alpha-BHC	0.011	NS	0.19 J
beta-BHC	0.037	NS	0.063 J
Heptachlor	0.015	0.4	0.057 J
<b>Total Metals</b>			
Arsenic	0.045	10	21.5
Cadmium	1.8	5	4.7 B
Chromium	11	100	14
Iron	1,100	NS	118,000
Lead	5	15	10.3
Manganese	73	NS	3,380
Vanadium	26	NS	28 B
<b>Dissolved Metals</b>			
Arsenic	0.045	10	17.6
Cadmium	1.8	5	2.4 B
Iron	1,100	NS	110,000
Manganese	73	NS	3,310

**SM13-GP02-01** - Nineteen VOCs, n-Nitrosodiphenylamine, p,p'-DDD, p,p'-DDT, 17 total metals, and 16 dissolved metals were detected above the limit of quantitation at SM13-GP02-01. Eight VOCs, p,p'-DDT, five total metals and three dissolved metals exceeded the Tap Water RBC. Benzene, PCE, TCE and vinyl chloride exceeded the MCL in addition to the Tap Water RBC.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
1,4-Dioxane (p-dioxane)	6.1	NS	130 L
Benzene	0.34	5	44
Chloroform	0.15	NS	16
cis-1,2-Dichloroethylene	6.1	70	65 J
Methyl tert-Butyl ether (MTBE)	2.6	NS	11
Tetrachloroethylene (PCE)	0.53	5	49 J
Trichloroethylene (TCE)	0.026	5	17 J
Vinyl Chloride	0.015	2	120
<b>Pesticides</b>			
p,p'-DDT	0.2	NS	0.48 J
<b>Total Metals</b>			
Arsenic	0.045	10	9.2 B
Chromium	11	100	11.8
Iron	1,100	NS	57,200
Lead	5	15	9.5
Manganese	73	NS	1,440
<b>Dissolved Metals</b>			
Arsenic	0.045	10	6.2 B
Iron	1,100	NS	51,200
Manganese	73	NS	1,390

A duplicate sample SM13-GP02-01A was collected at SM13-GP02-01 and yielded similar results; in both samples, SM13-GP02-01 and SM13-GP02-01A, total lead exceeded the Tap Water RBC. However, total chromium did not exceed the RBC as was the case for the actual sample and dissolved arsenic was an exceedance of the MCL at SM13-GP02-01A but did not exceed the standard in the actual sample.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
1,4-Dioxane (p-dioxane)	6.1	NS	170 L
Benzene	0.34	5	52
Chloroform	0.15	NS	7.3 B
cis-1,2-Dichloroethylene	6.1	70	59
Methyl tert-Butyl ether (MTBE)	2.6	NS	9
Tetrachloroethylene (PCE)	0.53	5	39 J

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
Trichloroethylene (TCE)	0.026	5	18 J
Vinyl Chloride	0.015	2	120
<b>Total Metals</b>			
Arsenic	0.045	10	8.8 B
Iron	1,100	NS	58,000
Lead	5	15	10.7
Manganese	73	NS	1,460
<b>Dissolved Metals</b>			
Arsenic	0.045	10	10.1
Iron	1,100	NS	48,700
Manganese	73	NS	1,340

Groundwater analytical results for SWMU 13 are presented graphically on Figure 15 and the individual constituents exceeding the Tap Water RBC and/or MCL and highlighted in bold. All groundwater analytical results are presented in Appendix F.

### 5.2.3 SWMU 14

Two groundwater samples were collected from the Test Pits 3 and 6 in SWMU 14 and were identified as SM14-TP03-01 and SM14-TP06-01 (Figure 16).

**SM14-TP03-01** - Three VOCs, two SVOCs, six pesticides, 18 total metals and 16 dissolved metals were detected above the limits of quantitation. PCE, TCE, nitrobenzene, five pesticides, seven total metals and five dissolved metals exceeded the Tap Water RBC. PCE, gamma-BHC (Lindane), total and dissolved cadmium, total copper, and total and dissolved lead exceeded the MCL at this sample location.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
Tetrachloroethylene (PCE)	0.53	5	310 J
Trichloroethylene (TCE)	0.026	5	3.8 J
<b>SVOCs</b>			
Nitrobenzene	0.35	NS	1.1 J
<b>Pesticides</b>			

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
alpha-BHC	0.011	NS	3.7 J
beta-BHC	0.037	NS	4.6 J
gamma-BHC (Lindane)	0.052	0.2	1 J
p,p'-DDD	0.28	NS	1.1 J
p,p'-DDT	0.2	NS	2.7 J
<b>Total Metals</b>			
Cadmium	1.8	5	46.2
Chromium	11	100	12
Copper	150	1,300	6,000
Iron	1,100	NS	1,990
Lead	5	15	186
Manganese	73	NS	171
Selenium	18	50	21.5
<b>Dissolved Metals</b>			
Cadmium	1.8	5	45.4
Copper	150	1,300	1,200
Lead	5	15	17.4
Manganese	73	NS	163
Selenium	18	50	20.9

**SM14-TP06-01** - Five VOCs, two SVOCs, beta-BHC, 9 total metals and one dissolved metal were detected above the limits of quantitation at this sample location. PCE, TCE, 1,3-Dinitrobenzene, nitrobenzene, beta-BHC, total chromium, total copper, and total lead exceeded the Tap Water RBC criteria. PCE, TCE and total lead exceeded the MCL at this sample location.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
Tetrachloroethylene (PCE)	0.53	5	200 J
Trichloroethylene (TCE)	0.026	5	5.6 J
<b>SVOCs</b>			
1,3-Dinitrobenzene	0.37	NS	300
Nitrobenzene	0.35	NS	4.9 J
<b>Pesticides</b>			
beta-BHC	0.037	NS	7.7 J

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>Total Metals</b>			
Chromium	11	100	91.2
Copper	150	1,300	951
Lead	5	15	42

A duplicate sample, SM14-TP06-01A, was collected at SM14-TP06-01 and was analyzed for total and dissolved copper. SM14-TP06-01A yielded very similar results to SM14-TP06-01 and detected total and dissolved copper; only total copper exceeded the Tap Water RBC for copper.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>Total Metals</b>			
Copper	150	1,300	953

Groundwater analytical results for SWMU 14 are presented graphically on Figure 16 and the individual constituents exceeding the Tap Water RBC and/or MCL and highlighted in bold. All groundwater analytical results are presented in Appendix F.

#### 5.2.4 SWMU 15

Three Geoprobe<sup>TM</sup> groundwater samples were collected near the test pits to assess the groundwater quality of SWMU 15. These groundwater samples were identified as SM15-GP01-01 through SM15-GP03-01 (Figure 17).

**SM15-GP01-01** - Seventeen VOCs, two SVOCs, alpha-BHC, and 16 total and dissolved metals were detected above the limit of quantitation at this sample location. Fifteen VOCs, alpha-BHC, three total and dissolved metals exceeded the Tap Water RBC. However, only seven VOCs and dissolved arsenic exceeded the MCL criteria at sample location SM15-GP01-01.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
1,1,2-Trichloro-1,2,2-trifluoroethane	5,900	NS	16,000
1,2-Dichloroethane	0.12	5	5,800
1,4-Dioxane (p-dioxane)	6.1	NS	34,000 L
4-Methyl-2-pentanone (MIBK)	200	NS	3,800
Acetone	61	NS	13,000 L
Benzene	0.34	5	10,000
Carbon tetrachloride	0.16	NS	500 J
Chloroform	0.15	NS	12,000
cis-1,2-Dichloroethylene	6.1	70	100,000
Ethylbenzene	130	700	770 J
Methylene Chloride	4.1	5	3,000
o-Xylene	21	10,000	740 J
p,m-Xylene	21	NS	2,800
Toluene	75	1,000	1,300 J
Trichloroethylene (TCE)	0.026	5	48,000 J
<b>Pesticides</b>			
alpha-BHC	0.011	NS	0.078 J
<b>Total Metals</b>			
Arsenic	0.045	10	7.1 B
Iron	1,100	NS	50,600
Manganese	73	NS	8,960
<b>Dissolved Metals</b>			
Arsenic	0.045	10	10.4
Iron	1,100	NS	50,500
Manganese	73	NS	8,940

A duplicate sample, SM15-GP01-01A, was collected at SM15-GP01-01 and yielded generally similar results. However carbon tetrachloride exceeded the Tap Water RBC in the actual sample but did not exceed the standard in SM15-GP01-01A, two SVOCs exceeded the Tap Water RBC in SM15-GP01-01A but did not exceed the standard in the actual sample, and dissolved arsenic was an exceedance of the MCL in SM15-GP01-01 but did not exceed the standard in the duplicate sample.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
1,1,2-Trichloro-1,2,2-trifluoroethane	5,900	NS	16,000
1,2-Dichloroethane	0.12	5	6,100
1,4-Dioxane (p-dioxane)	6.1	NS	25,000 L
4-Methyl-2-pentanone (MIBK)	200	NS	3,700
Acetone	61	NS	11,000 L
Benzene	0.34	5	9,600
Chloroform	0.15	NS	12,000
cis-1,2-Dichloroethylene	6.1	70	110,000
Ethylbenzene	130	700	700 J
Methylene Chloride	4.1	5	2,800 J
o-Xylene	21	10,000	700 J
p,m-Xylene	21	NS	2,600 J
Toluene	75	1,000	1,100 J
Trichloroethylene (TCE)	0.026	5	44,000
<b>SVOCs</b>			
1,2-Dichlorobenzene	27	600	270
Acetophenone	0.0042	NS	64 J
<b>Pesticides</b>			
alpha-BHC	0.011	NS	0.075 J
<b>Total Metals</b>			
Arsenic	0.045	10	7.2 B
Iron	1,100	NS	53,000
Manganese	73	NS	9,010
<b>Dissolved Metals</b>			
Arsenic	0.045	10	6.9 B
Iron	1,100	NS	43,800
Manganese	73	NS	8,220

**SM15-GP02-01** - Six VOCs, four SVOCs, three pesticides, six total metals and four dissolved metals were detected above the limit of quantitation at this sample location. Four VOCs, alpha-BHC and beta-BHC exceeded Tap Water RBC criteria and three VOCs exceeded the MCL.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
cis-1,2-Dichloroethylene	6.1	70	2,400
Methylene Chloride	4.1	5	17 J
o-Xylene	21	10,000	28 J
Trichloroethylene (TCE)	0.026	5	950 J
<b>Pesticides</b>			
alpha-BHC	0.011	NS	1.4 J
beta-BHC	0.037	NS	4.6 J

**SM15-GP03-01** - Ten VOCs, 21 total metals and 17 dissolved metals were detected above the limits of quantitation at this sample location. Seven VOCs, nine total metals, three dissolved metals exceeded the Tap Water RBC criteria and four VOCs, four total metals, two dissolved metals exceeded the MCL.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
Benzene	0.34	5	22
Chlorobenzene	11	100	130
Chloroform	0.15	NS	3.1 B
cis-1,2-Dichloroethylene	6.1	70	67
Tetrachloroethylene (PCE)	0.53	5	1.5 J
Trichloroethylene (TCE)	0.026	5	15
Vinyl Chloride	0.015	2	24
<b>Total Metals</b>			
Aluminum	3,700	NS	12,300
Antimony	1.5	6	12 B
Arsenic	0.045	10	35.1
Chromium	11	100	52.6
Copper	150	1,300	2,200
Iron	1,100	NS	13,500
Lead	5	15	93.6
Manganese	73	NS	946
Vanadium	26	NS	37.8 B
<b>Dissolved Metals</b>			
Antimony	1.5	6	15.6 B
Arsenic	0.045	10	18.4
Manganese	73	NS	717



Groundwater analytical results for SWMU 15 are presented graphically on Figure 17 and the individual constituents exceeding the Tap Water RBC and/or MCL and highlighted in bold. All groundwater analytical results are presented in Appendix F.

### 5.2.5 SWMU 17

One Geoprobe™ groundwater sample was driven to a depth of 7-ft to assess groundwater quality at SWMU 17 and was identified as SM17-GP01-01 (Figure 18). Eighteen VOCs, eight SVOCs, three pesticides, 23 total metals, 21 dissolved metals and cyanide were detected above the limit of quantitation at SM17-GP01-01. Sixteen VOCs, seven SVOCs, three pesticides, ten total metals, eight dissolved metals and cyanide exceeded the Tap Water RBC. Nine VOCs, 1,2-Dichlorobenzene, six total metals and three dissolved metals exceeded the MCL at SWMU 17.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
1,1,2-Trichloro-1,2,2-trifluoroethane	5,900	NS	18,000
1,2-Dichlorobenzene	27	600	37,000
1,4-Dichlorobenzene	0.47	75	410 J
Acetone	61	NS	3,700 J
Benzene	0.34	5	12,000
Bromoform	8.5	NS	2,800
Carbon tetrachloride	0.16	NS	1,600
Chlorobenzene	11	100	11,000
Chloroform	0.15	NS	28,000
Ethylbenzene	130	700	10,000
Methylene chloride	4.1	5	2,400
o-Xylene	21	10,000	3,500
p,m-Xylene	21	NS	18,000
Tetrachloroethylene (PCE)	0.53	5	23,000 J
Toluene	75	1,000	1700
Trichloroethylene (TCE)	0.026	5	36,000 J
<b>SVOCs</b>			
1,2-Dichlorobenzene	27	600	29,000 E
2,4-Dinitrophenol	7.3	NS	3,300 J
4-Nitrophenol	29	NS	4,500 J
Acetophenone	0.0042	NS	430 J

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
Nitrobenzene	0.35	NS	1,200 J
Phenol	1,100	NS	3,100 J
Pyridine	3.7	NS	3,600 J
<b>Pesticides</b>			
alpha-BHC	0.011	NS	850 J
p,p'-DDD	0.28	NS	2,400J
p,p'-DDT	0.2	NS	8,500 J
<b>Total Metals</b>			
Aluminum	3,700	NS	15,400 K
Antimony	1.5	6	2,840
Arsenic	0.045	10	863
Cadmium	1.8	5	5.7
Chromium	11	100	73.7
Iron	1,100	NS	10,200
Lead	5	15	794
Manganese	73	NS	976
Mercury	NS	2	33.4 L
Selenium	18	50	108
Vanadium	26	NS	28.2 B
<b>Dissolved Metals</b>			
Aluminum	3.700	NS	7,140 K
Antimony	1.5	6	2,400
Arsenic	0.045	10	474
Cadmium	1.8	5	2.4 B
Chromium	11	100	39.2
Lead	5	15	5.6
Manganese	73	NS	709
Selenium	18	50	96.3
<b>General Chemistry</b>			
Cyanide	73	200	77.6

Groundwater analytical results for SWMU 17 are presented graphically on Figure 18 and the individual constituents exceeding the Tap Water RBC and/or MCL and highlighted in bold. All groundwater analytical results are presented in Appendix F.

### 5.2.6 SWMU 18

Three Geoprobe™ groundwater samples were collected near the test pits to assess groundwater quality at SWMU 18 and were identified as SM18-GP01-01 through SM18-GP03-01 (Figure 19).

**SM18-GP01-01** - Six VOCs, three SVOCs, five Pesticides, 11 total and dissolved metals were detected above the limits of quantitation at this sample location. Five VOCs, one SVOC, four pesticides and two total and dissolved metals exceeded the Tap Water RBC.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
1,1,2-Trichloro-1,2,2-trifluoroethane	5,900	NS	60,000
1,2-Dichloroethane	0.12	5	28,000
2-Butanone (MEK)	190	NS	34,000 J
4-Methyl-2-pentanone (MIBK)	200	NS	87,000
Carbon disulfide	100	NS	86,000
<b>SVOCs</b>			
Hexachloroethane	3.65	NS	5.3 J
<b>Pesticides</b>			
alpha-BHC	0.011	NS	0.098 J
beta-BHC	0.037	NS	0.28 J
p,p'-DDD	0.28	NS	0.31 J
p,p'-DDT	0.2	NS	0.46 J
<b>Total Metals</b>			
Iron	1,100	NS	18,500
Manganese	73	NS	4,600
<b>Dissolved Metals</b>			
Iron	1,100	NS	17,700
Manganese	73	NS	4,610

**SM18-GP02-01** - Eight VOCs, three SVOCs, 20 total metals and 14 dissolved metals were detected above the limits of quantitation at SM18-GP02-01. Five VOCs, two pesticides, eight total metals, two dissolved metals exceeded the Tap Water RBC and two VOCs and one total metal exceeded the MCL.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
1,2-Dichlorobenzene	27	600	170 J
Carbon disulfide	100	NS	190 B
Chlorobenzene	11	100	240
cis-1,2-Dichloroethylene	6.1	70	150 J
Dichlorodifluoromethane	35	NS	160 J
<b>Pesticides</b>			
beta-BHC	0.037	NS	0.081 J
p,p'-DDT	0.2	NS	1.1 J
<b>Total Metals</b>			
Aluminum	3,700	NS	7,020 K
Arsenic	0.045	10	7.6 B
Barium	260	2,000	388
Chromium	11	100	38.9
Iron	1,100	NS	80,900
Lead	5	15	19.6
Manganese	73	NS	5,480
Vanadium	36	NS	68.7
<b>Dissolved Metals</b>			
Iron	1,100	NS	63,300
Manganese	73	NS	5,290

**SM18-GP03-01** - Five VOCs, bis(2-Ethylhexyl)phthalate, 16 total metals and 12 dissolved metals were detected above the limit of quantitation. TCE, two total and dissolved metals exceeded the Tap Water RBC. There were no exceedences of the MCL criteria at this location; MCLs do not exist for the pesticides.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
Trichloroethylene (TCE)	0.026	5	1.3 J
<b>Total Metals</b>			
Iron	1,100	NS	19,700
Manganese	73	NS	7,340
<b>Dissolved Metals</b>			
Iron	1,100	NS	15,500

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
Manganese	73	NS	7,340

Groundwater analytical results for SWMU 18 are presented graphically on Figure 19 and the individual constituents exceeding the Tap Water RBC and/or MCL and highlighted in bold. All groundwater analytical results are presented in Appendix F.

### 5.2.7 SWMU 19

One Geoprobe™ groundwater sample was collected near Test Pit 5 to assess the groundwater quality of SWMU 19 and was identified as SM19-GP01-01 (Figure 20). Chlorobenzene, four SVOCs, four pesticides and nine total metals were detected above the limits of quantitation. The semivolatile constituent 2-Chlorophenol, four pesticides, Cobalt and Nickel exceeded the Tap Water RBC and Chlorobenzene (3,200 µg/L), exceeded both the Tap Water RBC and MCL as presented on the table below:

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
Chlorobenzene	11	100	3,200
<b>Pesticides</b>			
alpha-BHC	0.011	NS	1.2 J
beta-BHC	0.037	NS	1 J
Dieldrin	0.0042	NS	0.33 J
p,p'-DDD	0.28	NS	2.8 J
<b>Total Metals</b>			
Cobalt	73	NS	77.8
Nickel	73	NS	73.9

Groundwater analytical results for SWMU 19 are presented graphically on Figure 20 and the individual constituents exceeding the Tap Water RBC and/or MCL and highlighted in bold. All groundwater analytical results are presented in Appendix F.

### 5.2.8 SWMU 20

Two Geoprobe™ groundwater samples were collected near Test Pits 2 and 3 to assess groundwater quality at SWMU 20 and were identified as SM20-GP01-01 and SM20-GP02-01 (Figure 21).

**SM20-GP01-01** - Seventeen total metals, 13 dissolved metals and Fluoride were detected above the limits of quantitation. Five total metals and two dissolved metals exceeded the Tap Water RBC. The MCL was not exceeded in this unit.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>Total Metals</b>			
Aluminum	3,700	NS	6,040 K
Chromium	11	100	17
Iron	1,100	NS	31,700
Manganese	73	NS	3,480
<b>Dissolved Metals</b>			
Iron	1,100	NS	4,620
Manganese	73	NS	2,820

**SM20-GP02-01** - TCE, two SVOCs, two pesticides and ten total metals were detected above the limits of quantitation at this sample location. Alpha-BHC, beta-BHC and Total Chromium exceeded the Tap Water RBC and TCE exceeded both the Tap Water RBC and MCL at this location.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
Trichloroethylene (TCE)	0.026	5	10 J
<b>Pesticides</b>			
alpha-BHC	0.011	NS	0.35 J
beta-BHC	0.037	NS	2.3 J
<b>Total Metals</b>			
Chromium	11	100	19.3

Groundwater analytical results for SWMU 20 are presented graphically on Figure 21 and the individual constituents exceeding the Tap Water RBC and/or MCL and highlighted in bold. All groundwater analytical results are presented in Appendix F.

### **5.2.9 Monitoring Wells**

Four monitoring wells were installed to assess the quality of groundwater on a site-wide basis and are identified as MW-1 through MW-4. MW-1 is located in the eastern corner of the site in a parking lot and is located just downgradient of SWMU 13. MW-2 is located in the northwestern corner of the site at the upgradient edge of SWMU-15 and serves as an upgradient well. MW-3 is located along the western edge of the site perimeter along the railroad tracks and serves as an upgradient well. MW-4 is located along Philadelphia Pike near the administration building and serves as a downgradient monitoring well. The monitoring well network is presented on Figure 3 and the monitoring well groundwater analytical data is presented in plan view on Figure 22.

**MW-1** - A total of 10 VOCs, 17 SVOCs, 12 pesticides, 15 total metals and 14 dissolved metals constituents were detected above the limits of quantitation.

- Nine of the ten VOCs detected above the limit of quantitation exceeded the Tap Water RBC and four VOCs exceeded the MCL.
- Eight SVOCs detections exceeded the Tap Water RBC; however, only two detections exceeded the MCL.
- Seven pesticide detections exceeded the Tap Water RBC. There were no exceedances of the MCL criteria; however, MCL criteria has only been established for two of the 12 pesticides detected in this sample.
- Three total metals exceeded the Tap Water RBC criteria. Total arsenic was detected at a concentration of 102 µg/L and exceeded both the Tap Water RBC and MCL.
- Four detected dissolved metals exceeded the Tap Water RBC; however, only dissolved arsenic exceeded its MCL. Dissolved arsenic was detected at a concentration of 98.7 µg/L and exceeded both the RBC and MCL.
- PCBs were not detected above the limits of quantitation in MW-1.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
1,1,2-Trichloro-1,2,2-trifluoroethane	5,900	NS	36,000
Acetone	61	NS	13,000 L
Chloroform	0.15	NS	41,000
cis-1,2-Dichloroethylene	6.1	70	3,500 J
Methylene chloride	4.1	5	440,000
Naphthalene	0.65	NS	4,800B
Tetrachloroethylene (PCE)	0.53	5	19,000 J
Tetrahydrofuran	8.8	NS	87,000 J
Trichloroethylene (TCE)	0.026	5	6,600 J
<b>SVOCs</b>			
1,2,4-Trichlorobenzene	0.72	70	1.4 J
1,2-Dichlorobenzene	27	600	4,300 D
1,3-Dichlorobenzene	18	NS	23
1,4-Dichlorobenzene	0.47	75	600 E
Acetophenone	0.0042	NS	5.5 J
Naphtahalene	0.65	NS	150 E
o-Toluidine	0.28	NS	3.1 J
Phenol	1,100	NS	24,000 J
<b>Pesticides</b>			
Aldrin	0.0039	NS	0.087 J
alpha-BHC	0.011	NS	0.19 J
beta-BHC	0.037	NS	0.5 J
Dieldrin	0.0042	NS	0.28 J
gamma-BHC (Lindane)	0.052	0.2	0.13 J
Heptachlor	0.015	0.4	0.12 J
p,p'-DDT	0.2	NS	0.21 J
<b>Total Metals</b>			
Arsenic	0.045	10	102
Iron	1,100	NS	302,000
Manganese	73	NS	5,870
<b>Dissolved Metals</b>			
Antimony	1.5	6	4.8 B
Arsenic	0.045	10	98.7
Iron	1,100	NS	288,000
Manganese	73	NS	5,540



A duplicate sample, MW-1A, was collected at MW-1 and yielded very similar results. All monitoring well analytical detections are presented graphically on Figure 22 and are presented in Appendix F.

**MW-2** - A total of five VOCs, two pesticides, 13 total metals and 12 dissolved metals were detected above the limit of quantitation in the sample collected from this well.

- Three of the five detected VOCs exceeded the RBC criteria; however, only TCE exceeded the MCL criteria.
- SVOCs and PCBs were not detected above the limit of quantitation.
- Both alpha-BHC and beta-BHC exceeded the Tap Water RBC; MCL criteria have not been established for either alpha-BHC or beta-BHC.
- Total and dissolved manganese exceeded the Tap Water RBC. MCL criteria has not been established for total and dissolved manganese.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
Chloroform	0.15	NS	14
cis-1,2-Dichloroethylene	6.1	70	9.5
Trichloroethylene (TCE)	0.026	5	40
<b>Pesticides</b>			
alpha-BHC	0.011	NS	1.2 J
beta-BHC	0.037	NS	9.8 J
<b>Total Metals</b>			
Manganese	73	NS	140
<b>Dissolved Metals</b>			
Manganese	73	NS	141

All monitoring well analytical detections are presented graphically on Figure 22 and are presented in Appendix F.

**MW-3** - Chlorobenzene, 2-Chlorophenol, two pesticides, 12 total metals and ten dissolved metals were detected above the limits of quantitation in the sample collected from this well.

- SVOCs and PCBs were not detected above the limit of quantitation in this sample.

- Chlorobenzene was detected at a concentration of 620 µg/L and exceeded both the RBC and MCL.
- Both alpha-BHC and beta-BHC exceeded the Tap Water RBC. MCL criteria have not been established for either alpha-BHC or beta-BHC.
- Total and dissolved iron and manganese exceeded the Tap Water RBC; however, the MCL criteria was not exceeded for these inorganics.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
Chlorobenzene	11	100	620
<b>Pesticides</b>			
alpha-BHC	0.011	NS	0.38 J
beta-BHC	0.037	NS	0.059 J
<b>Total Metals</b>			
Iron	1,100	NS	72,800
Manganese	73	NS	3,310
<b>Dissolved Metals</b>			
Iron	1,100	NS	73,700
Manganese	73	NS	3,360

All monitoring well analytical detections are presented graphically on Figure 22 and are presented in Appendix F.

**MW-4** - Two VOCs, Di-n-butyl phthalate, two pesticides, 15 total metals and 11 dissolved metals were detected above the limit of quantitation in this sample.

- Benzene and chlorobenzene exceeded the Tap Water RBC. Benzene did not exceed the MCL, but chlorobenzene exceeded both the RBC and MCL with a concentration of 270 µg/L.
- PCBs were not detected above the limits of quantitation in this sample.
- Both alpha-BHC and beta-BHC exceeded the Tap Water RBC. MCL criteria have not been established for either alpha-BHC or beta-BHC.
- Three total metals, arsenic, iron and manganese exceeded the Tap Water RBC; however, there were no exceedances of the MCL in this sample.

- Dissolved iron and dissolved manganese exceeded the Tap Water RBC criteria. MCL criteria have not been established for either dissolved iron or dissolved manganese.

Analyte	Tap Water RBC (µg/L)	MCL (µg/L)	Concentration (µg/L)
<b>VOCs</b>			
Benzene	0.34	5	3 J
Chlorobenzene	11	100	270
<b>Pesticides</b>			
alpha-BHC	0.011	NS	1.6 J
beta-BHC	0.037	NS	3.4 J
<b>Total Metals</b>			
Arsenic	0.045	10	4.9 B
Iron	1,100	NS	1,550
Manganese	73	NS	1,230
<b>Dissolved Metals</b>			
Iron	1,100	NS	1,450
Manganese	73	NS	1,220

All monitoring well analytical detections are presented graphically on Figure 22 and are presented in Appendix F.

## 6.0 SITE INVESTIGATION ANALYTICAL RESULTS FOR SURFACE WATER

Three runoff samples were collected during the RFI to characterize the surface water quality on SWMU 9. These surface water sample locations are presented on Figure 3 and the analytical results are presented in plan view on Figure 23. The samples were analyzed for total metals and were compared to the Delaware Surface Water Quality Criteria (DSWQC) and the National Recommended Water Quality Criteria (NRWQC) for Priority Toxic Pollutants for both Human Health and Ecological Criteria. Appendix G presents a complete list of surface water detections and exceedances.

**SM09-Runoff-01** – This sample was collected from the center of the lower level of SWMU 9. Twenty-two total metals were detected above the limit of quantitation. Four metals exceeded the Human Health criteria and seven metals exceeded the Ecological criteria.

The following section presents a synopsis of the constituents that exceeded the Human Health criteria:

- Arsenic was detected in the sample at a concentration of 97.1  $\mu\text{g/L}$ , which exceeds the DSWQC for fish and water consumption (50  $\mu\text{g/L}$ ), the NRWQC for fish consumption (0.14  $\mu\text{g/L}$ ), and the NRWQC for fish and water consumption (0.018  $\mu\text{g/L}$ ).
- Beryllium was detected in the sample at a concentration of 0.43 B  $\mu\text{g/L}$ , which exceeds the DSWQC for fish consumption criteria (0.08  $\mu\text{g/L}$ ) and the fish and water consumption criteria (0.0038  $\mu\text{g/L}$ ). This detection is suspect because it was detected in a laboratory blank at a similar concentration.
- Cadmium was detected in the sample at a concentration of 5.7  $\mu\text{g/L}$ , which exceeds the NRWQC for fish and water consumption (0.018  $\mu\text{g/L}$ ).
- Selenium was detected in the sample at a concentration of 27.5  $\mu\text{g/L}$ , which exceeds the DSWQC for fish and water consumption (10  $\mu\text{g/L}$ ).

The following section presents a synopsis of the constituents that exceeded the Ecological criteria:

- Aluminum was detected in the sample at a concentration of 9,720 µg/L, which exceeds the DSWQC acute and chronic standards of 750 µg/L and 87 µg/L, respectively.
- Cadmium was detected in the sample at a concentration of 5.7 µg/L, which exceeds the DSWQC acute and chronic standards of 2.79 µg/L and 0.895 µg/L, respectively. This detection also exceeds the NRWQC for the Criteria Maximum Concentration (CMC) and Criterion Continuous Concentration (CCC) standards of 2.0 µg/L and 0.25 µg/L, respectively.
- Copper was detected in the sample at a concentration of 103 µg/L, which exceeds the DSWQC acute and chronic standards of 13.3 µg/L and 9.14 µg/L, respectively. This detection also exceeds the NRWQC for CMC and CCC standards of 13 µg/L and 9 µg/L, respectively.
- Lead was detected in the sample at a concentration of 23.5 µg/L, which exceeds the DSWQC chronic standards of 2.17 µg/L and the NRWQC CCC standards of 2.5 µg/L.
- Mercury was detected in the sample at a concentration of 0.12 B µg/L, which exceeds the DSWQC chronic standards of 0.012 µg/L. This detection is suspect because it was detected in a laboratory blank at a similar concentration.
- Selenium was detected in the sample at a concentration of 27.5 µg/L, which exceeds the DSWQC acute and chronic standards of 20 µg/L and 5 µg/L, respectively. This detection also exceeds the NRWQC for CCC standard of 5 µg/L.
- Zinc was detected in the sample at a concentration of 668 µg/L, which exceeds the DSWQC acute and chronic standards of 90.67 µg/L and 82.12 µg/L, respectively. This detection also exceeds the NRWQC for CMC and CCC standards of 120 µg/L and 120 µg/L, respectively.

**SM09-Runoff-02** – This sample was collected from the center of the middle level of SWMU 9. Thirteen total metals were detected above the limit of quantitation; however, only aluminum and lead exceeded the Ecological criteria. There were no exceedances of the Human Health criteria.

The following section presents a synopsis of the constituents that exceeded the Ecological criteria:

- Aluminum was detected at a concentration of 2,170 µg/L, which exceeds the DSWQC acute and chronic standards of 750 µg/L and 87 µg/L, respectively.
- Lead was detected at a concentration of 11.5 µg/L, which exceeds the DSWQC chronic standard of 2.17 µg/L and exceeded the NRWQC CCC criteria of 2.5 µg/L.

**SM09-Runoff-03** – This sample was collected from the road to the middle level beneath the Western slope. Nineteen total metals were detected above the limit of quantitation; seven exceeded either the Delaware or NRWQC Ecological criteria. There were no exceedances of the Human Health criteria.

The following section presents the constituents that exceeded the Ecological criteria:

- Aluminum was detected at a concentration of 1,670 µg/L, which exceeds the DSWQC acute and chronic standards of 750 µg/L and 87 µg/L, respectively.
- Cadmium was detected in the sample at a concentration of 1.9 B µg/L, which exceeds the DSWQC chronic standard of 0.895 µg/L. This detection also exceeds the NRWQC CCC of 0.25 µg/L. This detection is suspect because it was detected in a laboratory blank at a similar concentration.
- Copper was detected in the sample at a concentration of 9.5 B µg/L, which exceeds the DSWQC chronic standard of 9.14 µg/L and exceeds the NRWQC CCC of 9 µg/L. This detection is suspect because it was detected in a laboratory blank at a similar concentration.
- Lead was detected at a concentration of 15 µg/L, which exceeds the DSWQC chronic standard of 2.17 µg/L and exceeded the NRWQC CCC criteria of 2.5 µg/L.
- Selenium was detected in the sample at a concentration of 6.8 µg/L, which exceeds the DSWQC chronic standard of 5 µg/L and the NRWQC CCC standard of 5 µg/L.

- Silver was detected in the sample at a concentration of 1.7 B µg/L, which exceeds the DSWQC chronic standard of 0.12 µg/L. This detection is suspect because it was detected in a laboratory blank at a similar concentration.
- Zinc was detected in the sample at a concentration of 235 µg/L, which exceeds the DSWQC acute and chronic standards of 90.67 µg/L and 82.12 µg/L, respectively. This detection also exceeds the NRWQC for CMC and CCC standards of 120 µg/L and 120 µg/L, respectively.

## Summary

Human health criteria were only exceeded in one sample (SM09-Runoff-01) for four constituents. Ecological criteria were exceeded in each of the three samples with a total of eight constituents exceeding one of the DSWQC or NRWQC criteria. Only mercury and silver were only detected in one sample. Four of the Ecological exceedances were blank qualified making their presence suspect.

## **7.0 GROUNDWATER FLOW ASSESSMENT**

Groundwater gauging events were performed on three occasions; the first was conducted on May 27, 2003 as part of a comprehensive gauging event, the second was conducted on June 3, 2003 prior to groundwater sampling, and the third was conducted on July 7, 2003 as part of a comprehensive gauging event. The data for each of these events is presented on Table 7. Data from the two comprehensive gauging events were used to develop potentiometric surface maps for the shallow water table that are presented as Figures 24 and 25.

The potentiometric surface maps for the two events compare quite favorably and indicate that groundwater flows from a potentiometric high located in the northern portion of the facility toward the Delaware River, which acts as a regional discharge point.

### **7.1 POTENTIOMETRIC SURFACE ELEVATION MAP FOR MAY 27, 2003**

As indicated on Figure 24, groundwater flows from the potentiometric high of 28.27 ft MSL at MW-2 toward the potentiometric low of 24.26 located at MW-4. Although not shown due to a lack of data in the South Plant, groundwater flows from the North Plant onward toward the southeast and southwest through the South Plant and ultimately to the Delaware River under a horizontal gradient of 0.005 ft/ft.

### **7.2 POTENTIOMETRIC SURFACE ELEVATION MAP FOR JULY 7, 2003**

As indicated on Figure 25, groundwater flows from the potentiometric high of 29.28 ft MSL at MW-2 toward the potentiometric low of 23.18 located at MW-102. Although not shown due to a lack of data in the South Plant, groundwater flows from the North Plant toward the southeast and southwest through the South Plant and ultimately to the Delaware River under a horizontal gradient of 0.006 ft/ft. The gradient was very slightly higher during the second comprehensive gauging event.